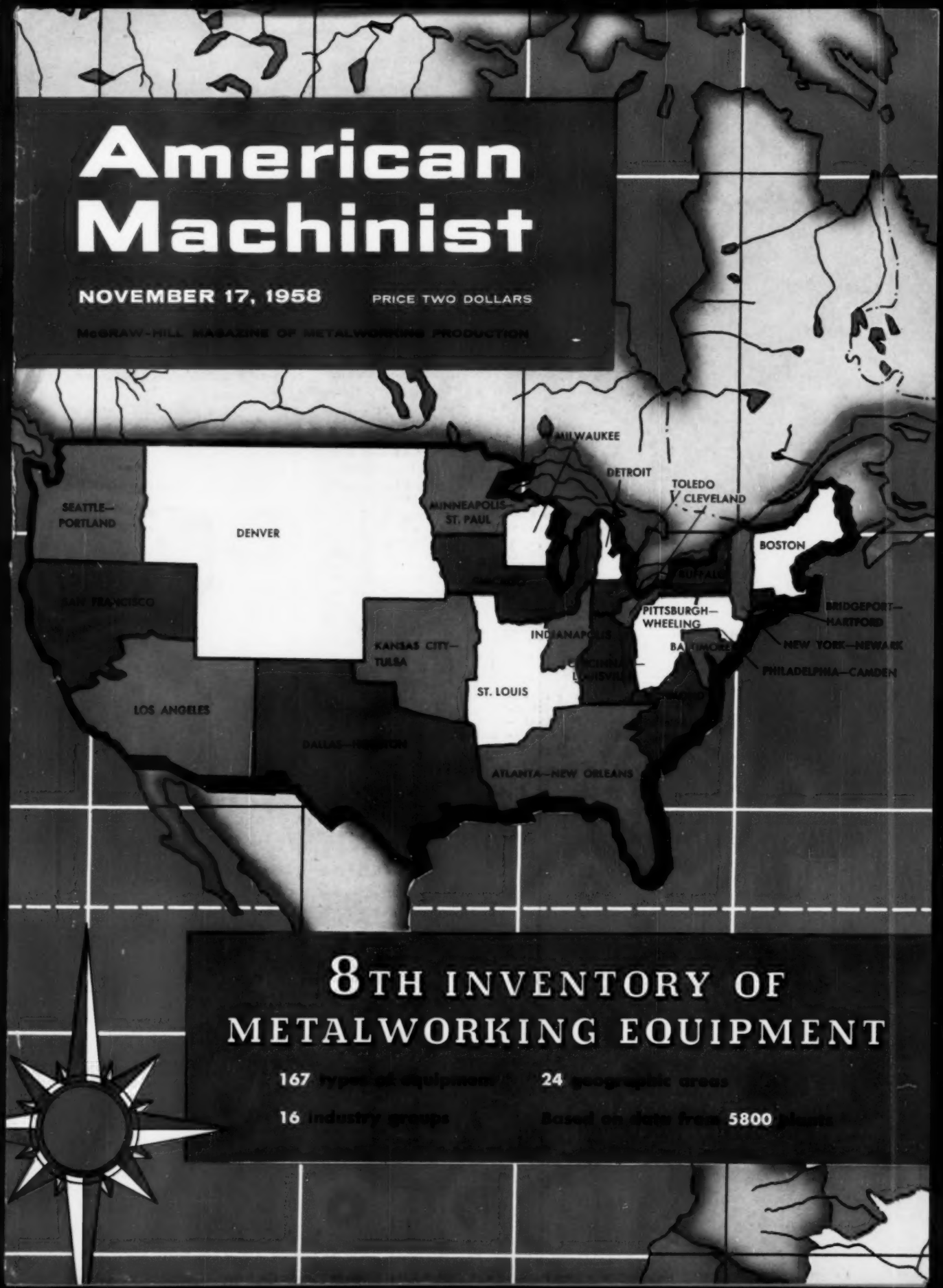
American Machinist
NOVEMBER 17, 1958
PRICE TWO DOLLARS
McGRAW-HILL MAGAZINE OF METALWORKING PRODUCTION
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8TH INVENTORY OF METALWORKING EQUIPMENT
167 types of equipment
24 geographic areas
16 industry groups
Based on data from 5800 plants

it's mainly a matter of TIMING!

Knowing WHEN to replace obsolete equipment with a new Heald Bore-Matic saved over $54,000 a year!

A MACHINE doesn't have to be very old in years to be obsolete as far as production costs are concerned. And after all, the purpose of any machine is not just to produce, but to produce at a *profit*.

That's why replacement timing is so important. It depends not only on the age and productive capacity of the old machine—but on a careful cost comparison between the old and the *new*. Such a comparison, in terms of investment and return, will tell you when equipment should be replaced, and when it should be retained.

Our sales engineers are well experienced in making such obsolescence studies—on Borizing and grinding equipment. And they will be glad to do the same for you. Similar studies have pointed the way to many important savings.

For Example: A manufacturer of aircraft control equipment purchased a Heald Model 222 Bore-Matic to replace older equipment for boring, turning, facing and grooving on a wide range of parts. Later, their engineers made a detailed analysis on 12 different parts, to evaluate its cost-saving performance in specific terms. It was found that the machine would save over $54,000 in production costs—not only *paying for itself*, but netting a *profit* of over $29,000 in just the first year! The cost comparison, by groups of parts, is shown below

	Old Method	New Machine
Annual Prod. Cost—Bodies	$53,004	$14,464
Annual Prod. Cost—Housings	18,124	4,917
Annual Prod. Cost—Carriers	3,276	1,404
Annual Prod. Cost—Plates	1,200	630
Total Cost per Year, all parts	$75,604	$21,415
Annual Saving for New Machine		$54,189
Total Purchase Price		$24,967
Net GAIN in One Year		$29,222

YOU pay for obsolescence. Replacement pays for itself!

THE HEALD MACHINE COMPANY

Subsidiary of The Cincinnati Milling Machine Co.

Worcester 6, Massachusetts

Chicago · Cleveland · Dayton · Detroit · Indianapolis · New York

HEALD ®

American Machinist
McGRAW-HILL MAGAZINE OF METALWORKING PRODUCTION

TRENDS

Spot News . . 105
Washington . . 107
Detroit . . 109
Aircraft and Missiles . . 111
Machine Tools . . 113
Materials . . 115
What's Ahead . . 117
News Report . . 83
Field Report . . 289

Departments...

Letters . . 96
Editorial . . 123
Practical Ideas . . 234
Talking Shop . . 233
Memos . . 233
New Equipment . . 237
Names . . 325
New Books . . 334

contents for November 17, 1958

VOLUME 102, NO. 24

The Eighth American Machinist Inventory of Metalworking Equipment 129

3 out of 5 machine tools are over-age. Inv-1
Grand Summary. Inv-2

Industry analysis: Modernization concentrated in two industries; over-age equipment tops 70% in three industries. Inv-6
Industry tables start. Inv-21
Nearly 3 million machine tools in US; three quarters of total is in metalworking Inv-10

Equipment analysis: Drop in percentage over 20 years old fails to halt trend to obsolescence. Inv-11
Equipment tables start. Inv-61

Geographic analysis: Shifts in machine concentration: East down, rest of country up. Inv-16
Geographic tables start. Inv-37

How the Inventory was taken. Inv-20

One-fourth of Nation's machine tools are outside metalworking. Inv-89
Maintenance and training tables. Inv-91

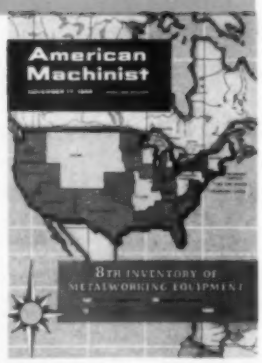
Index to tables. Inv-96

REFERENCE BOOK SHEETS

Slug disposal methods I, II . . . Fifteen examples of ways to get rid of slugs in push-through dies, inverted dies, and those using air cushions. *By Allan Young, Collins Radio Co.* 227

Torsional strength of shafts . . . A nomogram for solid and hollow shafts of equal torsional strength. *By Michael M Lachowski.* 231

American Machinist chips



Cover . . .

Map shows the 24 geographic divisions of the American Machinist Eighth Inventory. Design by Art Director Joe Poznanski.

Five-Year Count . . . What has been called the most comprehensive research project ever undertaken by a technical magazine makes its once-in-five-years appearance in this issue. Here are the long-awaited details of our Eighth Inventory. Two major conclusions emerge: The average age of equipment installed in Metalworking continues to rise; and the new equipment that has been installed is so much more productive that the *total number of machine tools has declined.* You will find the analysis as well as detailed tables in the 96-page Inventory section starting on page 129.

Automation Arrives . . . With a substantial increase in the number of plant reports on which the Inventory is based, the tabulation was automated. It took no less than 220,000 punched cards to handle the mass of data on reports representing 40% of Metalworking (up from 29% in 1953). The formula for expansion resulted in 1056 different expansion factors. The mechanical work was done at the computing laboratories of Data Computing Corporation and you see part of the programming operation being performed below.

Busy Man . . . Director of the Eighth Inventory was Associate Editor Tom Johnson, who has concentrated on the job for the past year. As steady kibitzers he has had Editor Burnham Finney, who takes a very personal interest in the Inventories, and Managing Editor Anderson Ashburn, who directed the Sixth and Seventh Inventories. The Inventory may have been automated this year, but the staff found plenty of problems in making the transition and developing the programming technique. It has been generally felt that data of this type could not practically be handled by punched cards, but a practical method was found.

Much credit goes to Charles Kornheister of Data Computing and to all the members of the *AM* editorial staff who pitched in whenever there was a crisis. Most credit of all, however, goes to the thousands of companies who took the time and effort required to supply the complex data required. You can find here the details on Metalworking that you can find nowhere else—and learn the best or worst about how your own plant stacks up in comparison with others.

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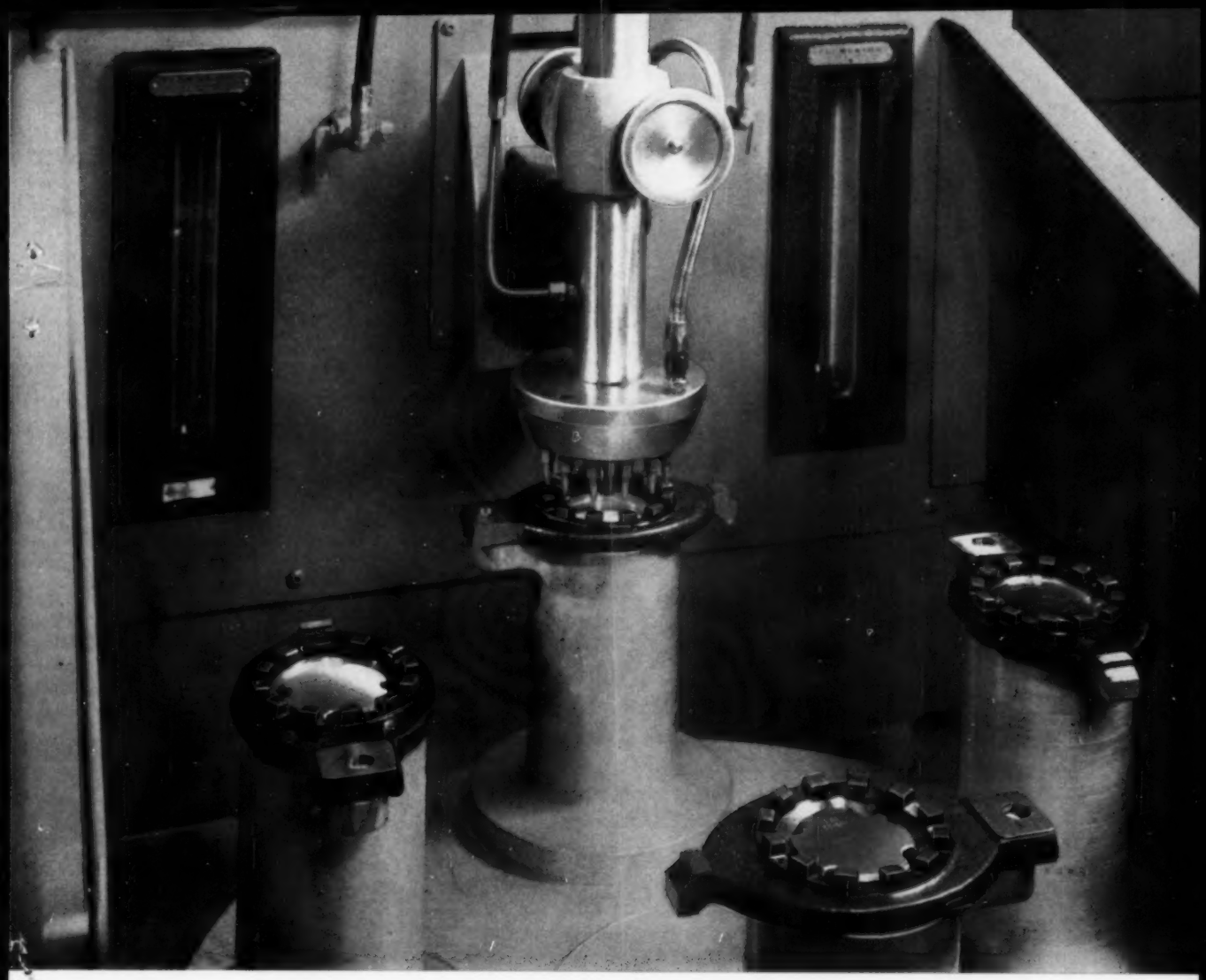


Now...*controlled hardening* of wearing surfaces

With these new Gleason machines you can make metal surfaces on couplings, splines, and other parts more wear-resistant by surface hardening.

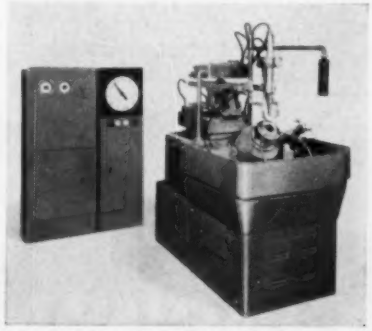
In the setup shown, the machine heats all twelve teeth of a coupling at once with a twelve-tip oxyacetylene burner. Indexing of work to the burners is automatically controlled.

A cam-controlled burner motion provides an oscillating movement of the burner tips to assure uniform penetration of the heating. This oscillating action in conjunction with electric timers controls the depth of hardness.

There is no measurable distortion because only the coupling teeth are heated and each tooth is heated uniformly on both sides, and the hardness is limited to the wearing surfaces. The life of the part is greatly increased.

You can set up the machine for small as well as volume production of parts up to 12″ diameter. Both ways, the machine is completely automatic except for loading.

This is one of a series of Gleason machines for hardening metal parts including bevel and hypoid gears and spur and helical gears. For additional information write for our bulletin. *Complete coupling is surface-hardened* in a single pass on the Gleason No. 108 Surface Hardening Machine.



Gleason No. 1 Gear Surface Hardener with electronic control unit. Accommodates bevel gears up to 24″ pitch diameter, spur and helical gears up to 30″, internal gears up to 24″ outside diameter.

GLEASON WORKS

Builders of bevel gear machinery for over 90 years

1000 UNIVERSITY AVE., ROCHESTER 3, N. Y.

CIRCLE 171 READER SERVICE CARD

CINCINNATI MILLING

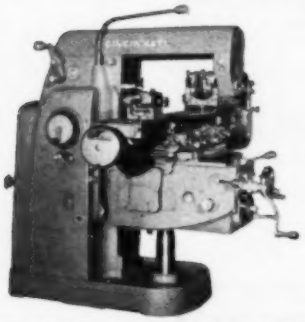
gives you a Supermarket Choice

of over 300

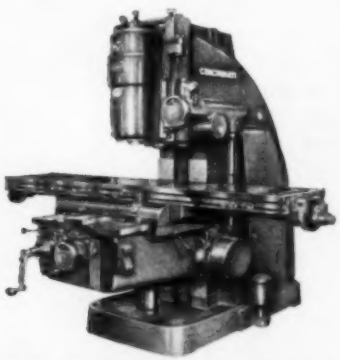
sizes, types and styles of standard milling machines; 5 cutter and tool grinders; several sizes and two styles of horizontal and vertical surface broaching machines. Just scan the list on these pages and you will find a machine exactly suited to your needs. Cincinnati also builds special and numerical controlled machine tools and complete production lines, engineered to definite cost specifications. The Cincinnati Milling Machine Co. has a well-deserved reputation for building the finest machine tools available. Each line of standard machines has family characteristics and exclusive feature-advantages, some of which are mentioned in the captions on the opposite page. Complete information is contained in individual catalogs. Brief information on the entire line may be obtained by writing for a copy of our general catalog No. M-1961-2.

CINCINNATI

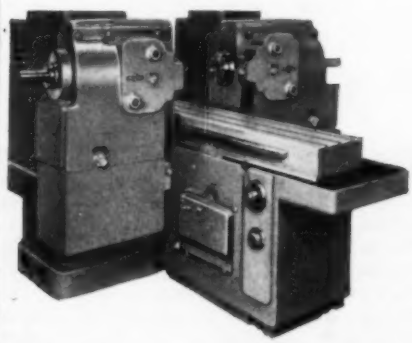
CINCINNATI
MILLING MACHINES



CINCINNATI Plain and Universal Milling Machines are equipped with Dynapoise chatter-damping overarms; directional controls; 150 ipm table rapid traverse; automatic backlash eliminator. Dial Types feature power speed and feed change.



CINCINNATI Vertical Milling Machines incorporate desirable features of the plain and universal styles, and in addition, all are equipped with power feed to the vertical head.

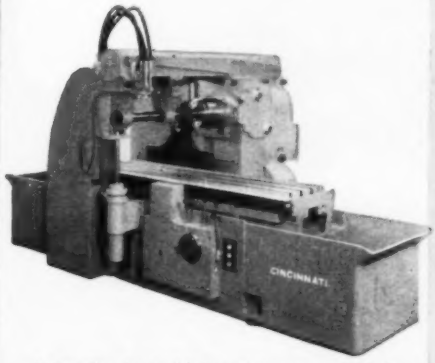


Bed type milling machines built by Cincinnati range from 4" table travel for the 000-4 to 168" for the largest HyPowermatic. All have automatic two-way table cycles.

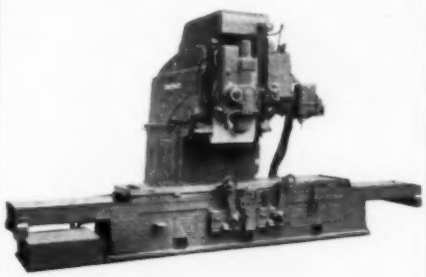
CINCINNATI® Knee Type Milling Machines • Bed Type Milling Machines

...knee type...bed type...die sinking

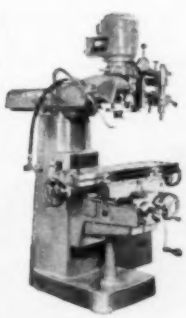
name, size and style	spindle drive motor, hp
Toolmaster	
1A and 1B	1
1C	2
1D	1½
ML; MI	
2ML, pl. and univ.	3
2MI, pl., univ., vert.	5
3MI, pl. and univ.	7½
Dial Type	
No. 2, pl., univ., vert.	10
No. 3, pl., univ., vert.	15
No. 4, pl., univ., vert.	20
High Power Dial Type	
No. 2, pl., univ., vert.	15
No. 3, pl., univ., vert.	20
No. 4, pl., univ., vert.	25
No. 5, pl., univ., vert.	25
No. 6, pl. and vert.	25
Dual Power Dial Type	
No. 2, pl., univ., vert.	20
No. 3, pl., univ., vert.	30
No. 4, pl., univ., vert.	50
No. 5, pl. and vert.	50
No. 6, pl. and vert.	50
Contourmaster	
1A, 1B, 1C	1
Hydro-Tel	
(several styles of each)	
16" Vertical	5
28" Vertical	7½ or 10
30" Vertical	20
36" Vertical	20 to 50
Automatic Profiler	
4-Spindle 360 degree	2 ea. pair
000-4 Automatic	
Unit Type	½ ea. spindle
0-8 Vertical	1
0-8 Automatic	
Plain; Rise and Fall	1½
1-18 Automatic	3
Powermatic	
(six sizes of each)	
Plain	5, 7½ or 10
Duplex	5, 7½ or 10
Plain Rise and Fall	5, 7½ or 10
Duplex Rise and Fall	5, 7½ or 10
HyPowermatic	
100 Series	
(four sizes of each)	
Plain	5
Duplex	5
Plain Rise and Fall	5
HyPowermatic	
(42 sizes of each)	
Plain	7½ to 50
Duplex	15 to 100
Plain, tracer controlled	7½ to 50
Duplex, tracer controlled	15 to 100



Automatic rise-and-fall and tracer controlled milling machines are built in many sizes. The 0-8 Automatic, Powermatic and 100 Series HyPowermatic lines are built in "rise-and-fall" styles; HyPowermatics are built in tracer controlled styles.



Vertical Hydro-Tel Milling Machines are built in 16", 28", 30" and 36" sizes; up to 120" table travel for the larger sizes. All can be equipped for general-purpose milling, die sinking, and/or automatic 360° profile milling.

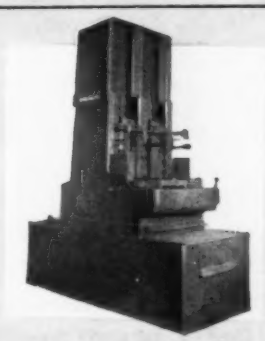


CINCINNATI Contourmaster Milling Machines are the finest equipment available for shops engaged in small to medium sized tool and die work. 16" or 22" table travel. Motor driven Shaping Attachment and many other extras available.

CUTTER AND TOOL GRINDERS

No. 1	8" swing, 15" between tailstock centers. For grinding a variety of small to medium sized cutters.
No. 2	10" swing, 27" between tailstock centers. For grinding a variety of medium to large sized cutters.
Monoset	For grinding and salvaging small to medium sized cutters of unusual shapes.
Contour	For grinding form milling cutters on the periphery of the cutting edges.
Projecto-Form	For grinding small form cutters and die parts. 20X optical comparison.

BROADCHING MACHINES



Cincinnati pioneered in many types of surface broaching operations, and now builds an extensive standard line of this type of equipment:

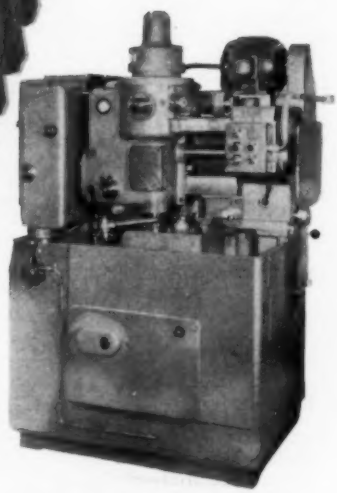
Vertical	S. Ram ... 1 to 25 tons broaching force Duplex ... 1 to 25 tons broaching force
Horizontal	..... One and two direction broaching, 10 to 25 tons broaching force

Die Sinking Machines • Cutter and Tool Grinders

MILLING MACHINE DIVISION
The Cincinnati Milling Machine Co.
Cincinnati 9, Ohio

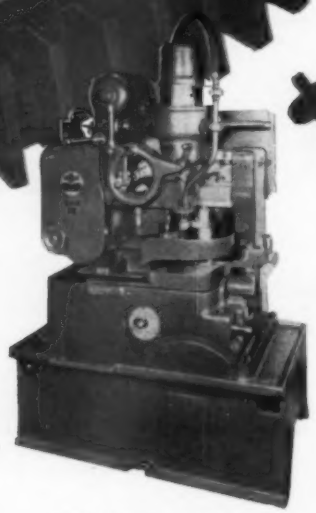
CIRCLE 172 READER SERVICE CARD

In Every Size Range ...Cut Costs with



FELLOWS NO. 4GS

Among the products for which gears are cut on the 4GS are automatic transmissions, gasoline motors, hoist and well drilling equipment, computers and aircraft reduction gear units.



FELLOWS 7A-TYPE

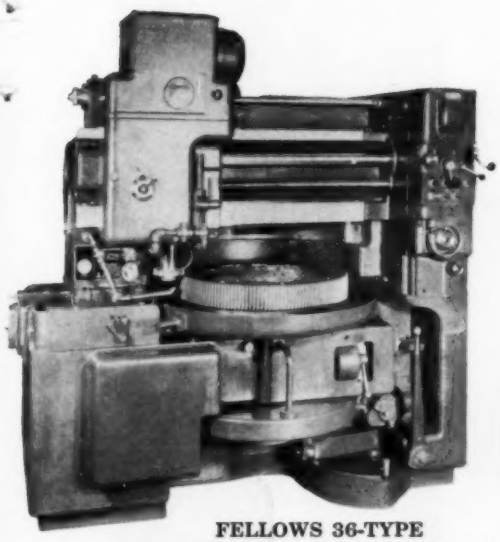
Gears cut on the 7A are used in textile machinery, servo-mechanisms, washing machines, cash registers, lawn mowers, machine tools and motorcycle engines.

FELLOWS 3-INCH FINE-PITCH

Used to cut gears for computers, bomb director and gun fire control systems, aircraft and flight control instruments, cameras and electro-mechanical mechanisms.

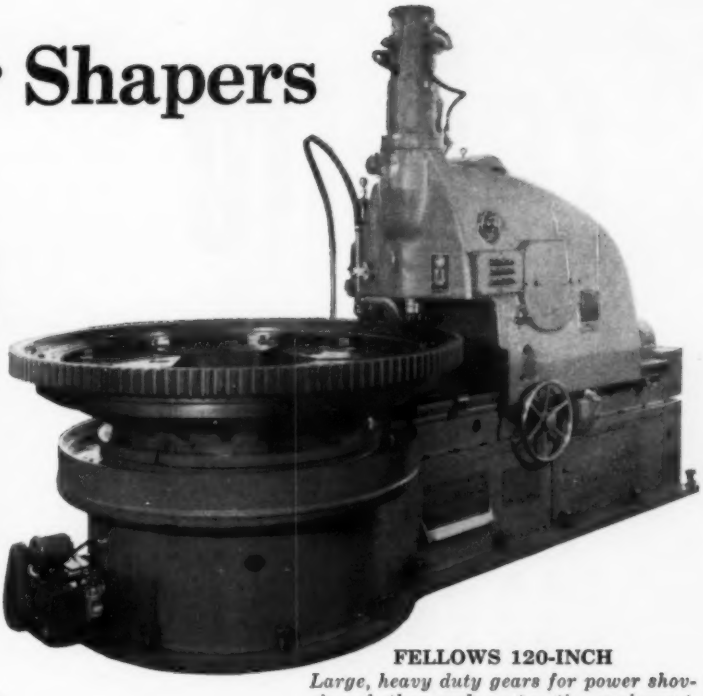
THE PRECISION LINE

Fellows Gear Shapers



FELLOWS 36-TYPE

Gears for construction equipment, textile machines, mining machinery, industrial truck transmissions, tractors, cranes and hoists are cut on this machine.



FELLOWS 120-INCH

Large, heavy duty gears for power shovels and other road construction equipment, heavy cranes, gun segments, tank turrets and winches are cut on the 120-Inch.

Modernizing cuts costs. In many plants the speed and versatility of new Fellows Gear Shapers has lowered gear production costs by more than a third and repaid the investment in just a few years.

Gear Shapers are ideal for many non-involute shapes too, such as internal and external splines, cams, clutches and nearly every other conceivable shape. Modifications to the Gear Shaper permit rapid, economical production of oval or elliptical gears. Fellows machines are available for either full- or semi-automatic operation for high speed, long-run production with a minimum of operator attention.

Your Fellows representative can show you where and how new machines from Fellows' Precision Line can lower your costs for small lots as well as for long production runs. Ask him for the facts.

THE FELLOWS GEAR SHAPER COMPANY
78 River Street, Springfield, Vermont
Branch Offices: 1048 North Woodward Ave., Royal Oak, Mich.
150 West Pleasant Ave., Maywood, N. J.
5835 West North Avenue, Chicago 39
6214 West Manchester Ave., Los Angeles 45

Fellows *Gear Production Equipment*

rolling taper pipe threads

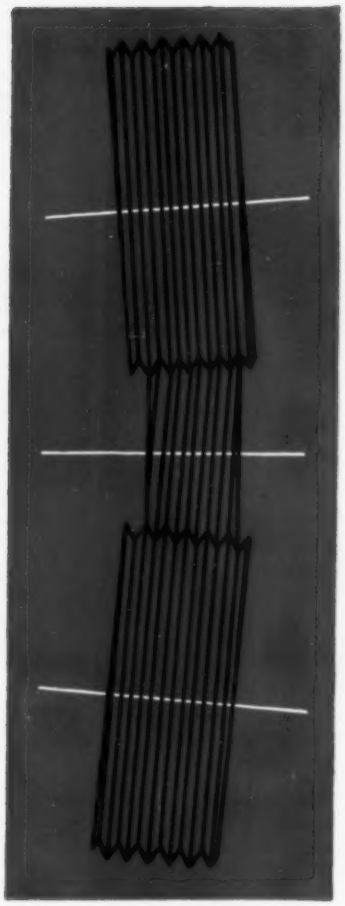
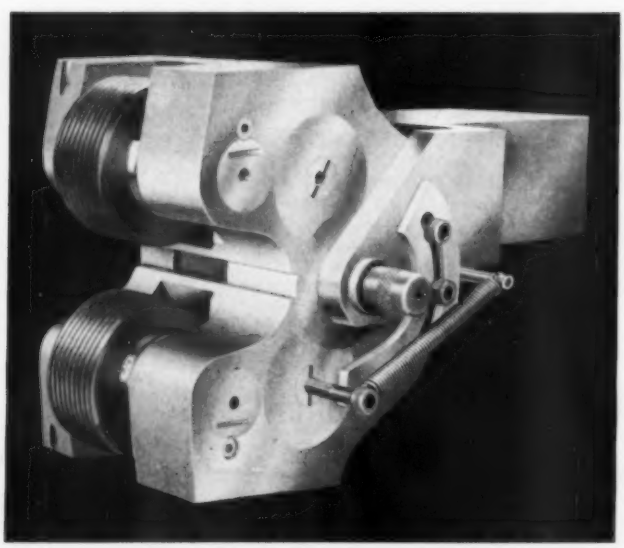


Figure 1

with the LANROLL thread rolling attachment



Thread-roll wear is minimized by the recently developed LANDIS Method (Patents Pending) for precision rolling of taper pipe threads (including dry-seal).

To produce the taper, the rolls of the LANROLL Attachment are supported on carbide shafts inclined to the required thread taper. This design enables the use of parallel rolls (see Figure 1) which reduces slippage between the workpiece and the rolls. With reduced slippage, roll life is materially increased. In addition, attachment stabilization (limited sidewise movement)

470-C

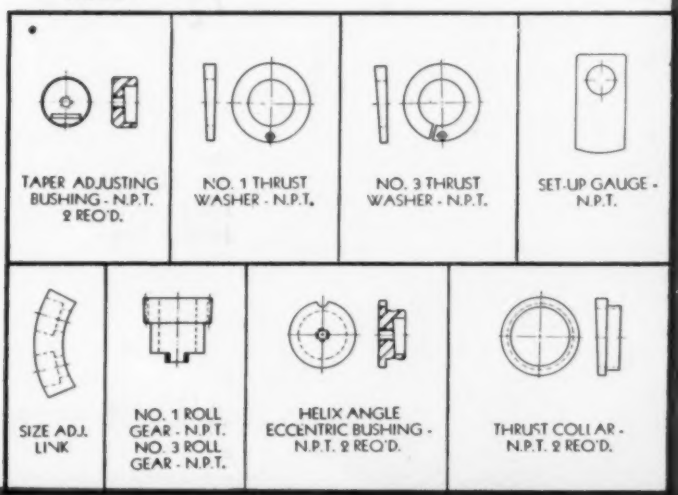
is greatly improved to permit rolling directly to a shoulder with safety.

Of an adjustable design, the LANROLL Attachments provide wide range coverage while retaining the rigidity of a non-adjustable tool. Either straight or tapered threads can now be produced with the same attachment through the use of proper rolls and auxiliary equipment. Five sizes with varying dimensions are available for use on the many sizes and makes of bar automatics, and will produce coarse pitch threads to Class 4 tolerances on all diameters from #5 to 1¾" for straight threads, and precision pipe threads from 1/16" to 1¼" in diameter.

In addition to proper rolls, the auxiliary equipment necessary to change from straight to taper threading is negligible, as illustrated in Figure 2. When changing from one pipe size to another within the range of the attachment, the size adjusting link, set-up gage and rolls are the only equipment changes required. With this design tooling flexibility is obtained with minimum cost. These changes assure operation of the attachment for every size within its range as though it were exclusively engineered for the particular work being threaded. Also, the same simplified and precise methods of set-up and roll timing used for straight threading are used for taper threading.

For additional information ask for Bulletin G-96 and specify straight or taper work.

Figure 2


TAPER ADJUSTING BUSHING - N.P.T. 2 REQ'D.
NO. 1 THRUST WASHER - N.P.T.
NO. 3 THRUST WASHER - N.P.T.
SET-UP GAUGE - N.P.T.
SIZE ADJ. LINK
NO. 1 ROLL GEAR - N.P.T.
NO. 3 ROLL GEAR - N.P.T.
HELIX ANGLE ECCENTRIC BUSHING - N.P.T. 2 REQ'D.
THRUST COLLAR - N.P.T. 2 REQ'D.

longer roll life with LANDIS parallel-roll method

Note that in producing a taper thread one end of each roll is required to thread a larger diameter than its opposite end. This results in unequal circumferential travel by the respective roll ends during each revolution. However, in traveling these unequal distances both ends of the roll make a revolution in the same interval of time. Therefore, the end of each roll on a large thread diameter must travel at a higher peripheral velocity than its opposite end on the small diameter. These necessary differentials in peripheral velocities for the roll ends can only exist by slippage between the roll and the workpiece. This slippage becomes more acute on the larger diameters as the differentials become greater or where tapered rolls on parallel axis are used. **By presenting parallel rolls to the workpiece, the LANDIS Method (see Figure 1) reduces the differentials in peripheral velocities and its accompanying roll slippage.** Roll life, of course, is greatly benefited by any reduction of slippage.

In developing a roll diameter for a particular thread, the pitch diameter of the workpiece is used as a basis. If the workpiece is straight, the relationship of the roll diameter to the workpiece diameter remains constant. For taper threads the roll diameter is normally developed from the pitch diameter at the mid-point of the effective thread. Thus, the diameter of the roll thread in respect to the diameter of the workpiece thread will only agree at one point. On either side of this point the roll diameter will be either too large or too small. This disagreement in the roll and workpiece diameter relationship results in attachment instability (sidewise movement). Maximum instability occurs if taper threads are produced with tapered rolls on parallel axis as the relationship of the roll and workpiece diameters vary in direct opposition. This instability becomes more apparent on the larger diameters as wider thread rolls having a greater disagreement are required to produce the longer thread lengths. **By use of parallel rolls on inclined axis (see Figure 1) the LANDIS Method reduces disagreement in the relationship of the roll and and workpiece diameter by one half.** In this case, both ends of each roll have a pitch diameter equal to the P.D. from which the roll was developed. Improved attachment stabilization results and rolling to a shoulder can be accomplished with safety.

LANDIS Machine COMPANY WAYNESBORO PENNSYLVANIA

Pump manufacturer cuts grinding cycle

. . . Landis grinder with angular wheel head grinds

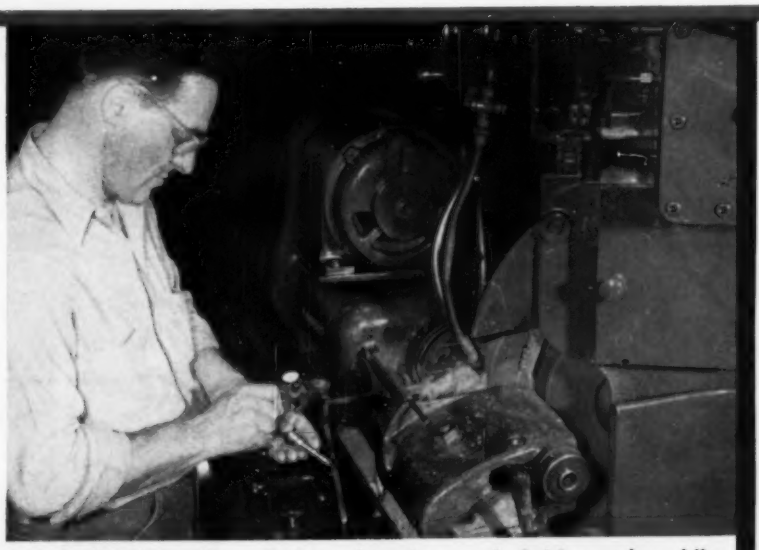
- **One control starts work rotating, coolant flow, and advances wheel head**
- **Profiled wheel dressed automatically without breaking setup**
- **Grinds to a tolerance of .0003" on diameter**

Landis 6" x 18" Type CH Plain Grinder with angular wheel head and overhead dresser

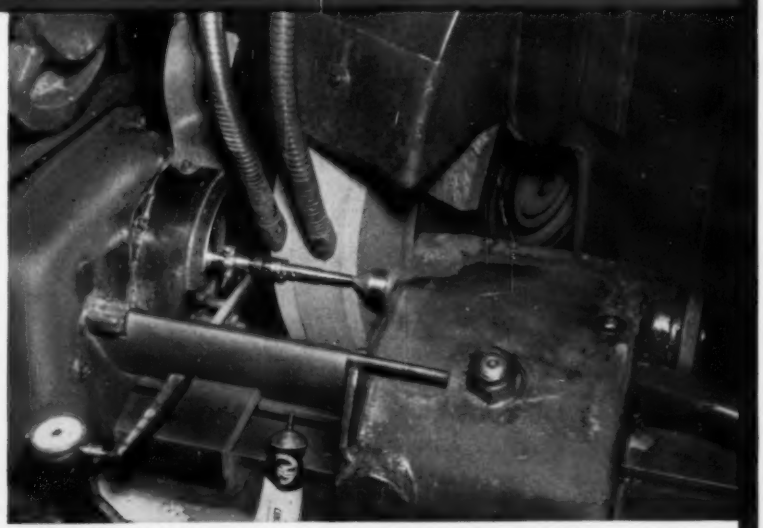
LANDIS TOOL COMPANY

# of multi-diameter shaft by 80%

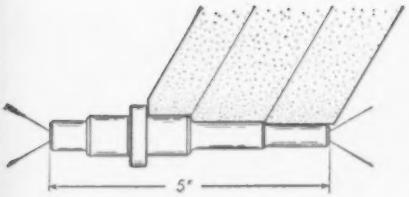
3 diameters and face in one operation



Spot checks of workpiece for size and finish made while another piece is being ground.



Lateral locator used to align the workpiece before advancing the wheel.



production data

Machine:	Landis 6''x 18''Type CH Plain Grinder with 30° angular wheel head
Part:	Multi-diameter pump shaft
Operation:	Infeed grinding 3 diameters and adjacent face at one time
Cycle time:	20-22 seconds, including handling
Material:	C-1144
Hardness:	65 Rockwell C
Stock removal:	.010''-.015''
Finish:	10-20 Micro-inch
Tolerance:	.0003'' on the bearing diameter

WAYNESBORO, PENNSYLVANIA

LANDIS

precision grinders

CIRCLE 175 READER SERVICE CARD

"Competitors wonder how I'm cutting production costs . . . the answer is

MORSE Electrolized TOOLS"

Production costs are tough to control nowadays. But if you can get up to 100% more production out of the cutting tools you use . . . then you've got a real competitive edge.

That's exactly what you can do, with Morse Electrolized Tools on your machines. Not only do you get more production, but you get it cleaner and faster with more closely held tolerances over a longer period of time.

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MORSE TWIST DRILL & MACHINE COMPANY, NEW BEDFORD, MASSACHUSETTS

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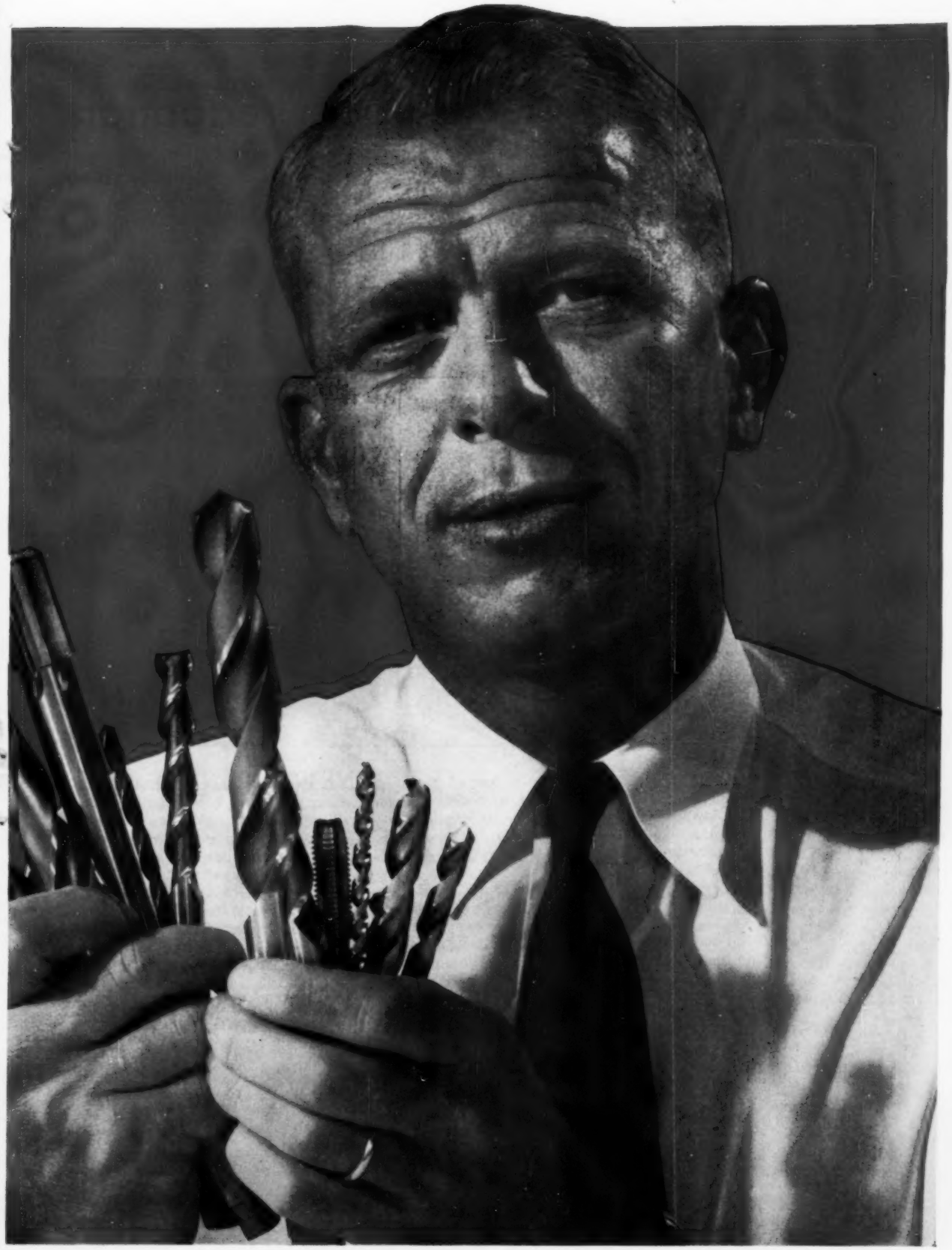
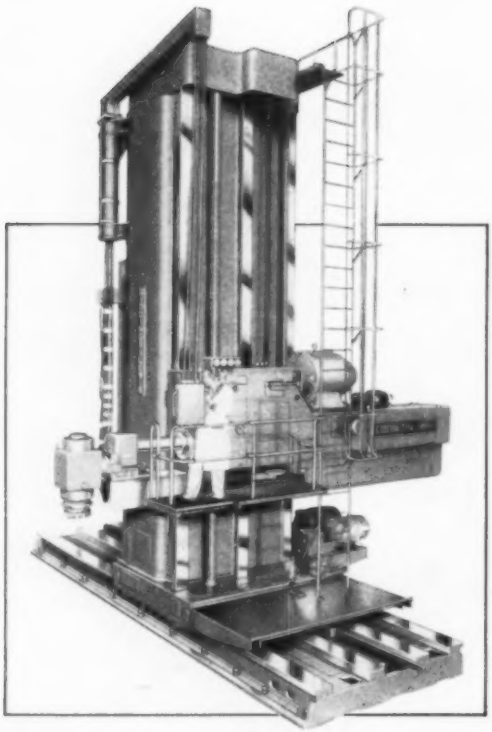
Cutting Tools



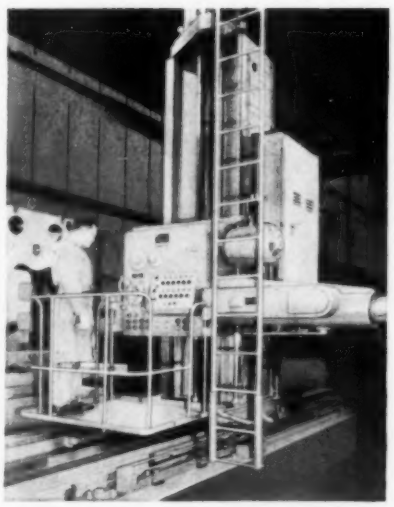
Ideas on tooling for cost reduction



NEW. Designed to reduce the cost of heavy drilling, large-hole boring, and heavy milling on huge workpieces, G&L's new 8″ or 10″ spindle 80 Series machines feature more than 20 feet of vertical headstock travel.

Machines are available with an underarm; cross-sliding column; or a planer-type reciprocating table.

Giddings & Lewis offers table-, floor-, and planer-type horizontals with spindle diameters ranging from 3″ through 14″ and with electronic controls for template tracing, numerical positioning, or numerical contouring. ASK FOR CATALOG 80-F.



NEW. This tape-controlled Kauna-Matic horizontal boring, drilling, and milling machine has effected a 30% direct cost reduction in machining printing press parts. Big additional savings come from elimination of jigs and fixtures. The simple, punched paper tape control system repeats to ±.001″ accuracy. These 4″ or 5″ dia. spindle machines also can be operated by manual pushbutton or digital dial control. A product of G&L's Kaukauna Machine Division. ASK FOR CATALOG H-6.

All these operations, and more—for faster machining, less handling, fewer setups, with versatile G&L horizontal bars

Backfacing with continuous feed facing head.

Turning and boring with continuous feed facing head.

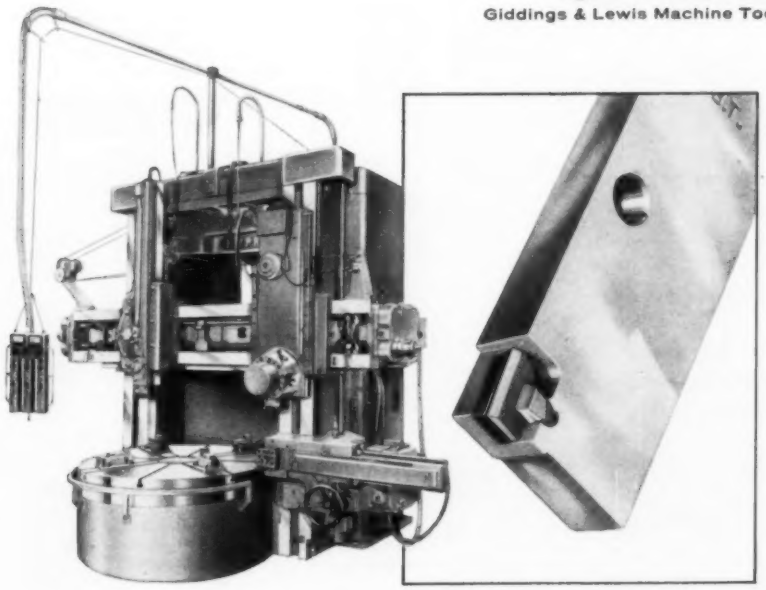
with new multi-purpose Giddings & Lewis machines

Pictured here are a few of the opportunities for reducing workhandling—for multiple tooling—and for combining on one machine jobs commonly routed to two or more different machines.

Faster and fewer setups—faster machining—fewer nonproductive operations—easier, faster operation—quicker tool changes—and increased machine utilization are among the factors that warrant your full investigation of G&L equipment. Call your G&L distributor, or write.

GIDDINGS & LEWIS

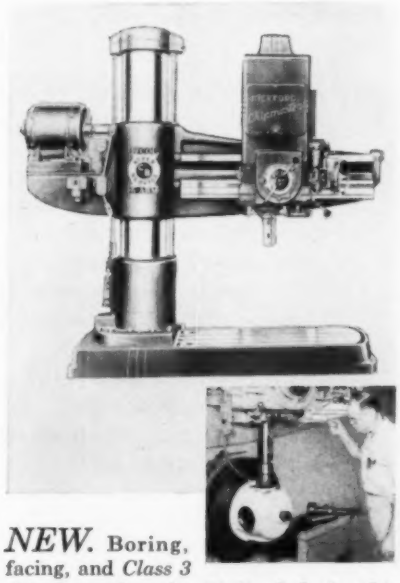
Giddings & Lewis Machine Tool Company, Fond du Lac, Wisconsin



NEW. A vertical boring and turning mill with speed and control that put it out in front for cost reduction. Complete remote control from a pendant station includes preselect of all ram and saddle feeds. Optional constant cutting speed increases tool life, reduces downtime—table speed changes made without stopping or changing gear. Table diameters from 54″ to 14′. Tracer or magnetic tape control available. ASK FOR CATALOG VBM-4.

NEW. With Davis throwaway tip cutters for block-type boring tools, you can profitably speed up machines even at the expense of tool life. Here's why: (1) instant tool change with minimum downtime; (2) carbide grinding eliminated; (3) low cost per cutting edge—eight edges on negative rake tool, four on positive rake tool; (4) less tool inventory required.

This is a development of G&L's Davis Boring Tool Division. ASK FOR BULLETIN DB410.



NEW. Boring, facing, and *Class 3 thread tapping* of a 5″ dia. hole in 1½ minutes on the Chipmaster radial—12.5% the previous machining time!

Product of G&L's Cincinnati Bickford Division, the all-new Chipmaster has preloaded bearing spindle to take severe thrust loads of heavy boring, spade drilling, and facing. Instant spindle reversal at speeds to 2300 rpm cuts tapping costs. 4′—13″ to 8′—19″ sizes. ASK FOR CATALOG R-35.

Keyway Cutting with underarm and shaper head.

Boring and Turning Diameters up to 150″ with tool on face plate drive.

Angular Milling attachment mounted on underarm.

Extending Machine Range to save repositioning of work.

CINCINNATI

gives you a selection of

160

sizes types and styles of Precision Grinding Machines

One-stop shopping for precision cylindrical grinding machines, ideas and methods is another advantage offered by the Grinding Machine Division of The Cincinnati Milling Machine Co. This Division builds nine types of precision grinders . . .

plain . . . universal . . . production universal . . . angular wheel slide . . . gap . . . roll . . . centerless . . . Micro-Centric . . . chucking

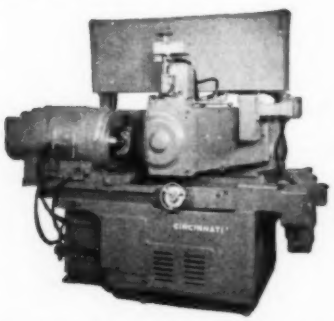
All are tabulated in the column at the right. Cincinnati also builds special grinding machines and complete precision production lines, such as those employed in the anti-friction bearing industry. Every precision grinding machine built by Cincinnati is equipped with FILMATIC grinding wheel spindle bearings, a lifetime, zero-maintenance construction.

Complete feature-advantages and specifications are contained in individual catalogs for each family type. Brief information on the entire line may be obtained by writing for a copy of our general catalog No. M-1961-2.

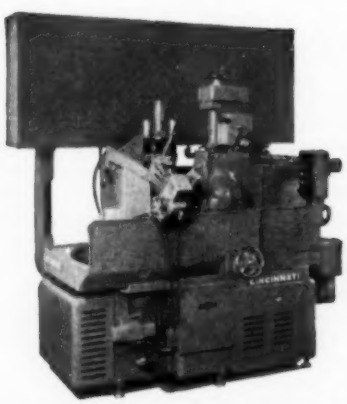
CINCINNATI

CINCINNATI

Centerless grinding machines. Cincinnati is the only manufacturer of a complete line of these machines. No. 2 size (illustrated) has the widest range of application; for small lot or automatic production. Nos. 5 and 6 sizes are tooled up for specific jobs.



Chucking grinders are built in single and double work-spindle styles. Can be equipped for manual loading or completely automatic operation. Double spindle machines are continuous producers; alternate grinding and loading.



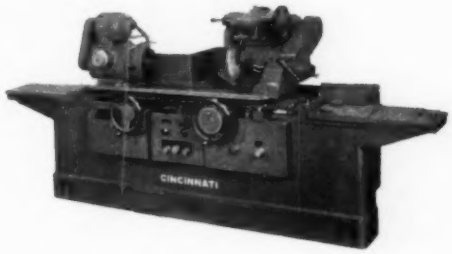
Micro-Centric grinding machines operate on a unique principle which generates accuracies within .000025" round and square with one end on comparatively short parts. May be tooled up for completely automatic production.

CINCINNATI®

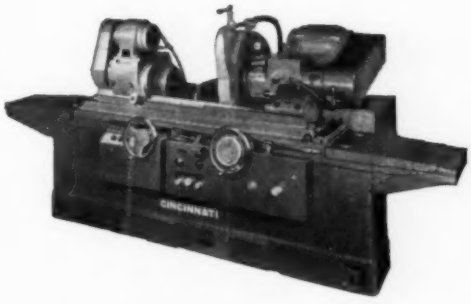
CENTERTYPE GRINDING MACHINES • CENTERLESS
MICRO-CENTRIC GRINDING MACHINES • CHUCKING

FILMATIC GRINDING MACHINES

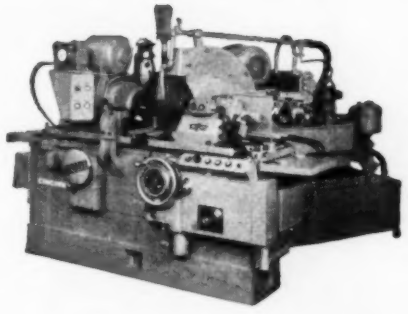
machine	capacity	spindle drive
	Length Between Centers	
Universals		
10"	24"	2 hp
12"	36", 48", 72"	3 hp
14"	36", 48", 72"	5 hp
18"	36", 48", 72"	5 hp
Production Universal		
10"	24"	5 hp
Plain		
4"	18"	3 hp
6"R	18", 30"	7½ hp
10"L	18", 30"	7½ hp
10"R	18", 36", 48", 72", 96"	15 hp
14"L	18", 36", 48", 72", 96"	15 hp
14"	36", 48", 72", 96", 120", 144", 168"	20 hp
16"	36", 48", 72", 96", 120", 144", 168"	20 hp
18"	48", 72", 96", 120", 144", 168", 192", 216", 240"	25 hp
24"	48", 72", 96", 120", 144", 168", 192", 216", 240"	25 hp
20" H.D.	96", 120", 144", 168", 192"	30 hp
24" H.D.	96", 120", 144", 168", 192"	30 hp
28" H.D.	96", 120", 144", 168", 192"	30 hp
Angular Wheel Slide		
6"R (30° or 45°)	18", 30"	7½ hp
10"L (30° or 45°)	18", 30"	7½ hp
10"R (30° or 45°)	18", 36", 48", 72"	15 hp
14"L (30° or 45°)	18", 36", 48", 72"	15 hp
Gap		
16" (40" swing in gap)	96", 120", 144", 168"	20 hp
Roll		
18" (Traveling Table)	48", 72", 96", 120", 144", 168", 192", 216", 240"	25 hp
24" (Traveling Table)	48", 72", 96", 120", 144", 168", 192", 216", 240"	25 hp
20" H.D. (Trav. Table)	96", 120", 144", 168", 192"	30 hp
24" H.D. (Trav. Table)	96", 120", 144", 168", 192"	30 hp
28" H.D. (Trav. Table)	96", 120", 144", 168", 192"	30 hp
36" (Trav. Wheelhead)	120", 144", 168", 192", 216", 240"	30/40 hp
44" (Trav. Wheelhead)	144", 168", 192", 216", 240", 264", 288"	30/40 hp
50" (Trav. Wheelhead)	144", 168", 192", 216", 240", 264", 288"	30/40 hp
60" (Trav. Wheelhead)	144", 168", 192", 216", 240", 264", 288"	30/40 hp
Centerless	Work Diam.	
No. 1	0-1½"	7½ hp
No. 2	⅛"-4¾"	15 hp
No. 3	½"-6"	25 hp
No. 4	½"-9"	30 hp
No. 5	1"-7"	75 hp max.
No. 6	1"-10"	75 hp max.
Chucking		
No. 1	0-4"	5 hp
No. 2	2-10"	7½ hp
Micro-Centric		
No. 1	⅛"-4"	5 hp
No. 2	2"-10"	7½ hp
Centerless Lapping	⅛"-6"	7½ hp



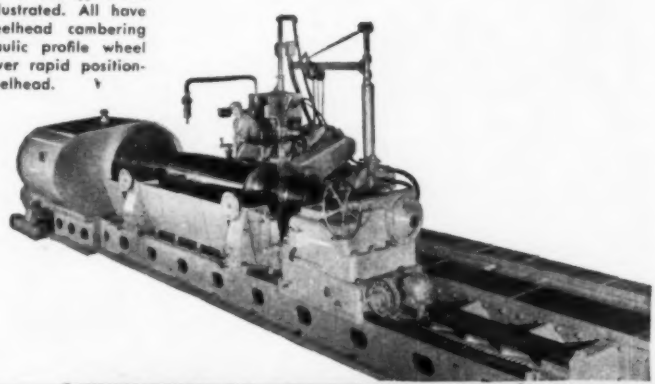
Universal grinding machines. Permanently mounted hinged internal grinding head, infinite range of headstock speeds, two-speed hand table traverse and other features minimize setup time. 10" machine may be equipped for production grinding.



Plain grinding machines. Automatic grinding wheel balancing is standard equipment for 6"R to 16" machines. Automatic Air-Electric Gage Sizing, Gage Line attachment, Dual Rate Automatic Infeed and other cost-reducing equipment available for 4" to 14"L sizes. Larger machines are industry's first choice for heavy duty work.



Angular wheel slide grinding machines. For grinding shoulder and adjacent diameter, by means of automatic infeed grinding cycles. May be equipped for complete automation. Automatic grinding wheel balancing is standard equipment. 10"R and 14"L machines will accommodate 6" wide wheels.



Roll grinding machines are built in traveling table and traveling wheelhead types. The latter is illustrated. All have tilting wheelhead cambering unit; hydraulic profile wheel truing; power rapid positioning of wheelhead.

GRINDING MACHINES • ROLL GRINDING MACHINES
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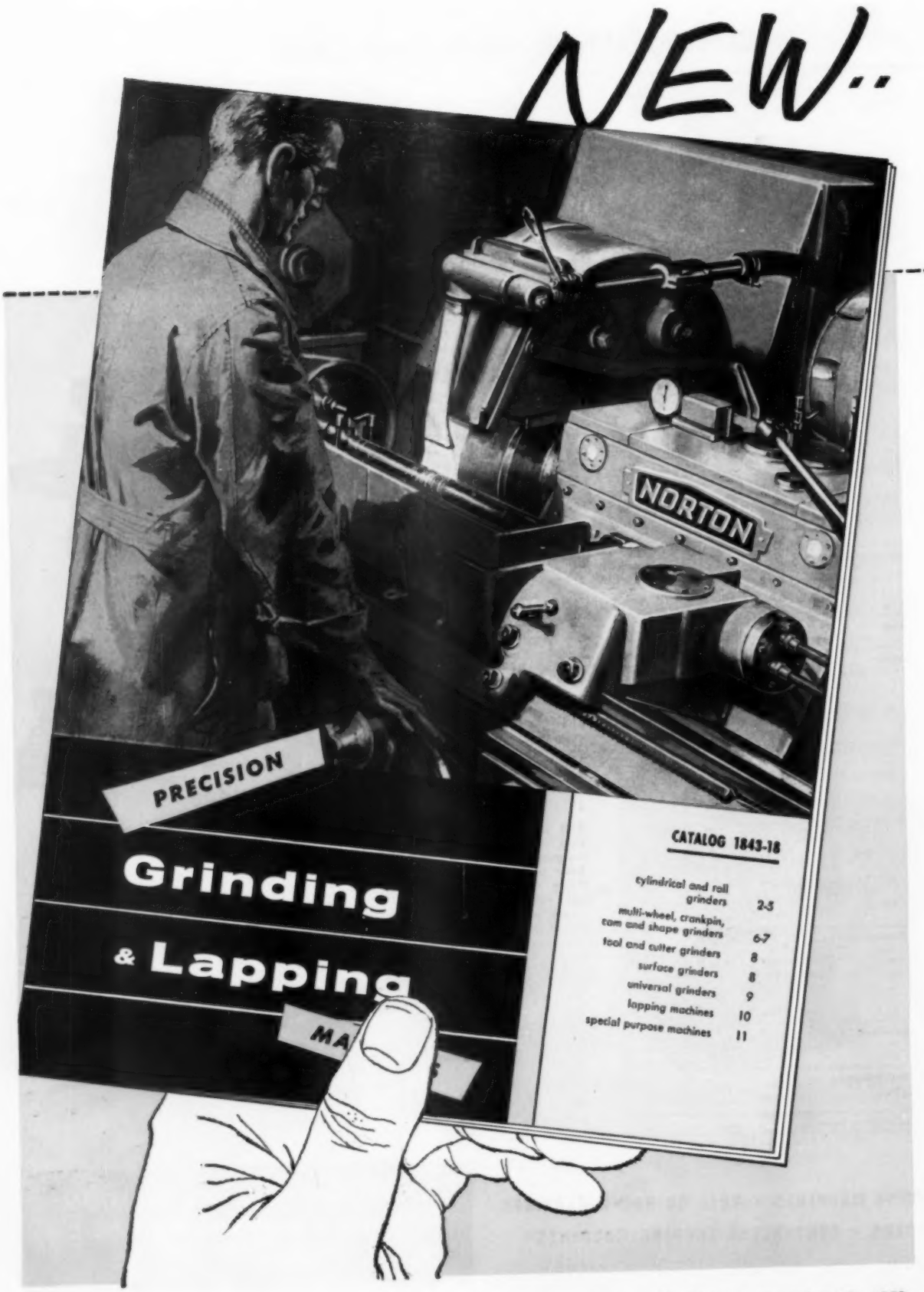
GRINDING MACHINE DIVISION
The Cincinnati Milling Machine Co.
Cincinnati 9, Ohio

CIRCLE 178 READER SERVICE CARD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multi-wheel, crankpin, cam and shape grinders 6-7
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surface grinders 8
universal grinders 9
lapping machines 10
special purpose machines 11

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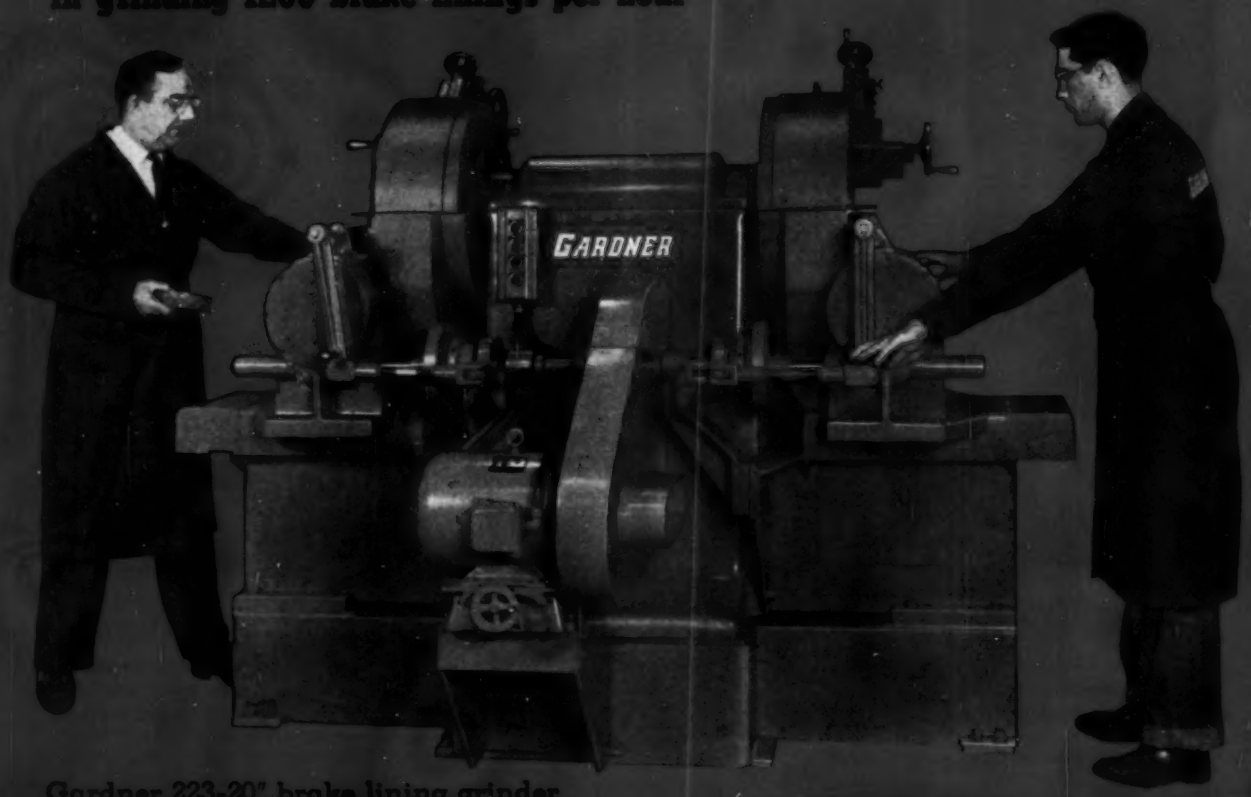
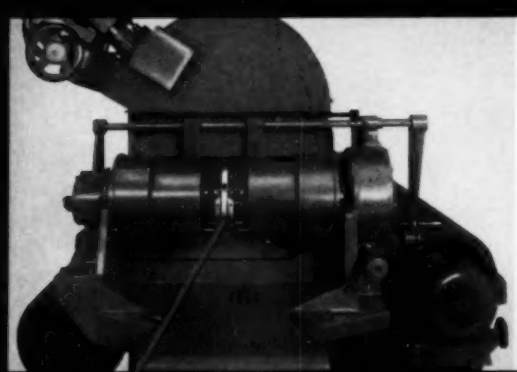
Curved surfaces ground with flat discs

Gardner 223-20″ gives economical high production in grinding 1200 brake linings per hour



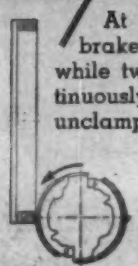
Gardner 223-20″ brake lining grinder



Machine grinds two sizes of brake linings —a different size at each end

production data

Machine:	Gardner 223-20″ Single Horizontal Spindle Grinder
Fixturing:	Right and left hand rotary drum fixtures
Workpieces:	Two different sizes of brake lining
Operation:	Grinding outside, curved surface
Production:	1200 parts per hour
Stock removal:	1/32″ maximum



At each end of the machine, two brake shoe linings are being ground while two are being loaded on the continuously rotating fixture. Clamping and unclamping are automatic.

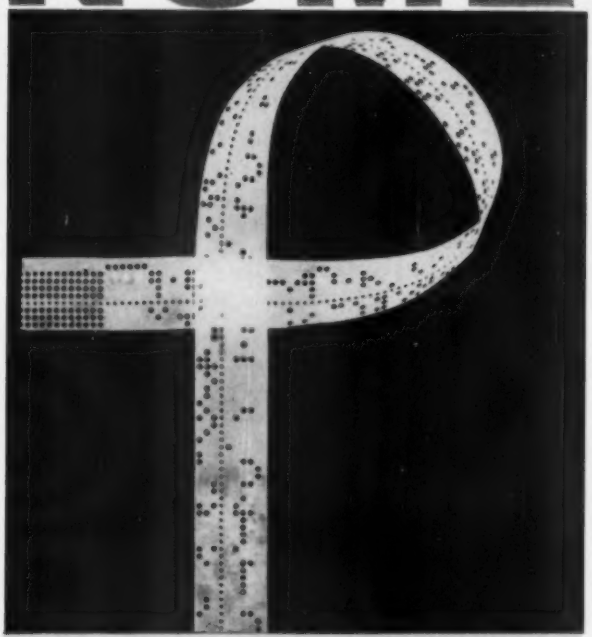
Send prints of your parts for a Gardner proposal.

GARDNER

precision disc grinders

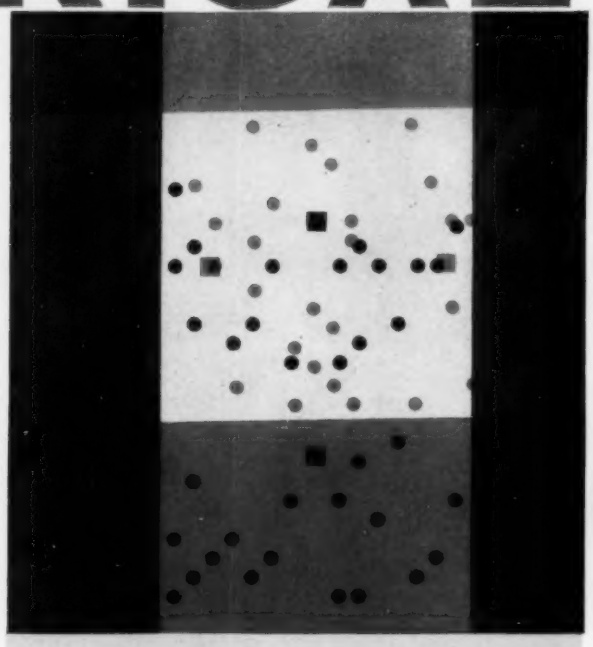
BELOIT, WISCONSIN

NUMERICAL



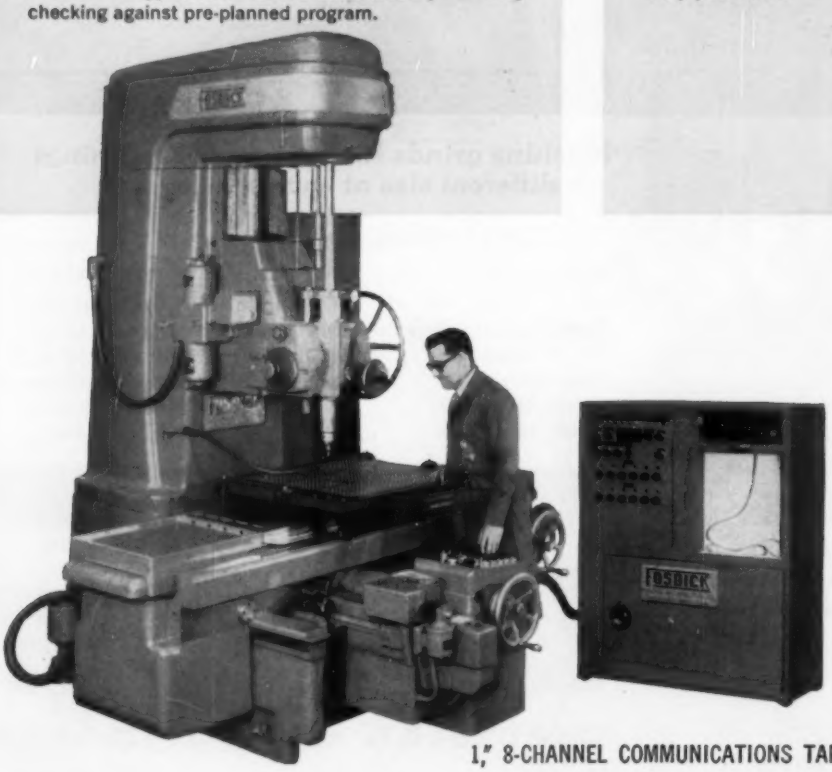
1," 8-CHANNEL COMMUNICATIONS TAPE

Inexpensive, widely used throughout industry, these tapes may be prepared simply on a Flexowriter or similar equipment, usually by the Production Engineering Dept. Provides a typewritten record automatically for easy checking against pre-planned program.



4" MYLAR PLASTIC TAPE

Least expensive of the generally accepted tape systems, particularly suitable for smaller shops machining parts with relatively few holes. Tape can be prepared easily by shop personnel.

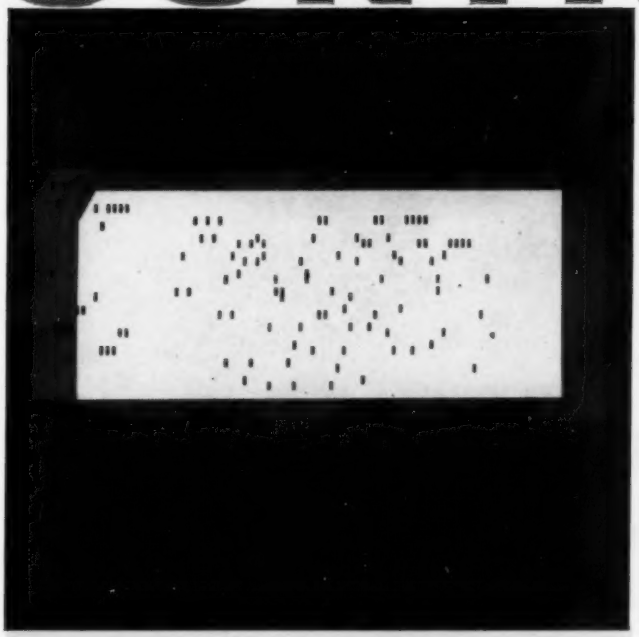


1," 8-CHANNEL COMMUNICATIONS TAPE

4" MYLAR PLASTIC TAPE

CONTROL

for Fosmatic JIG BORERS and JIG GRINDERS



PUNCHED CARDS

This system can be integrated with card systems already in use by your company. Each job is programmed in a "deck" of cards; provides great flexibility, since an operation can be added or eliminated simply by making a new card or removing an old one.

Any tape or card reader can be used to control a Fosmatic Jig Borer or Jig Grinder. And because the functions of the standard Fosmatic are actuated electrically, numerical control can be installed in the field—economically!

Speeds and feeds are changed by controlling electro-magnetic clutches through relay contacts. Table and saddle position is determined by a measuring system actuated by direct reading dials. For numerical control, these dials are driven by a fractional hp motor.

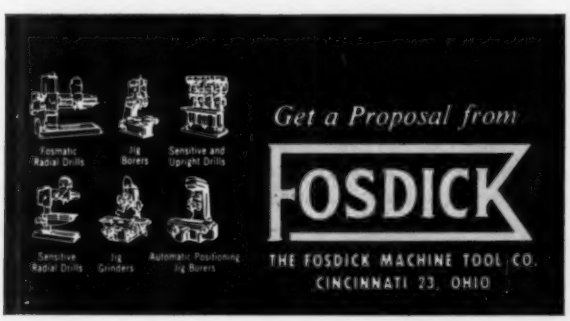
On a Fosmatic, you can program as many functions as you wish. Table X and Y positions (to .0001"), Feeds and Speeds, Spindle start and stop, Spindle feed start and stop, Spindle feed depth, Spindle head height, Automatic tool change. And only Fosmatic gives you a visual numerical check of coordinate location plus operation sequence number.

Example of savings made with Fosmatic numerical control. The illustration (left) shows one half of a mold with 900 cavities, each of which requires nine operations—a total of 8100! Time for the entire job was 100.25 hours, 25% of time consumed previously on a conventional jig borer.

Write or call today for complete information on a numerically controlled jig borer or jig grinder to improve your production method.

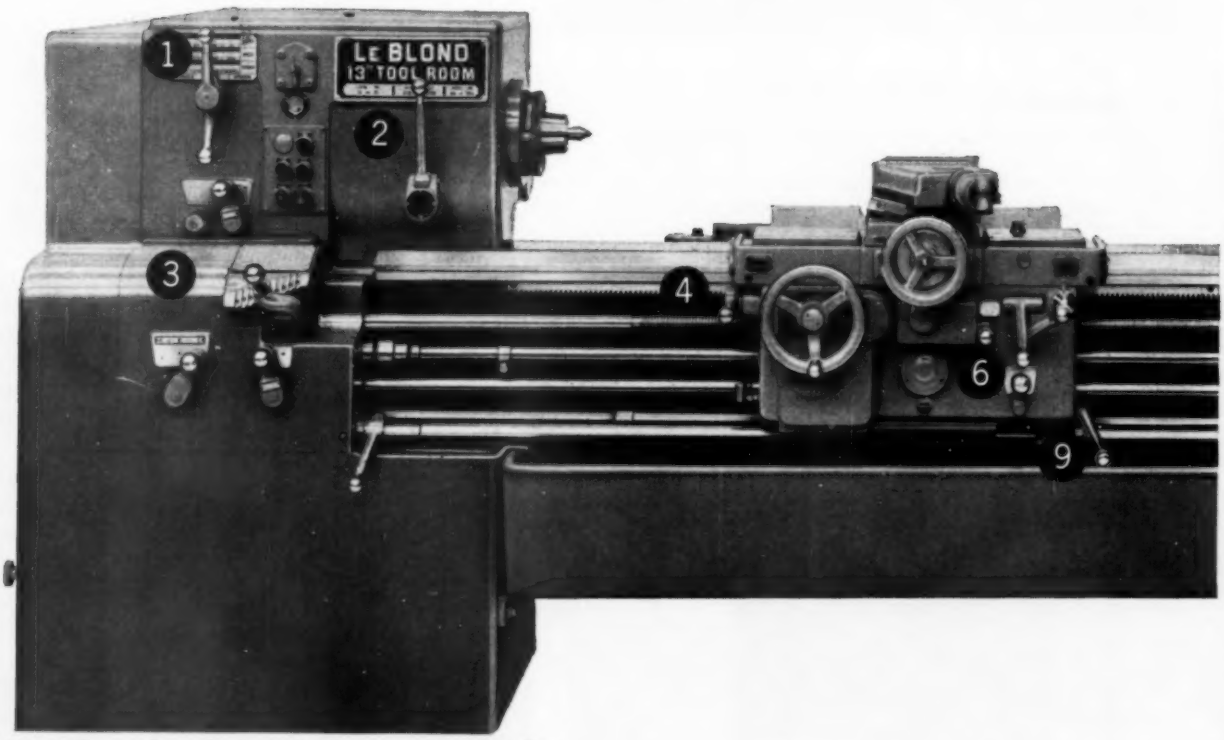
PUNCHED CARDS

Buy a Fosmatic today—add Numerical Control tomorrow

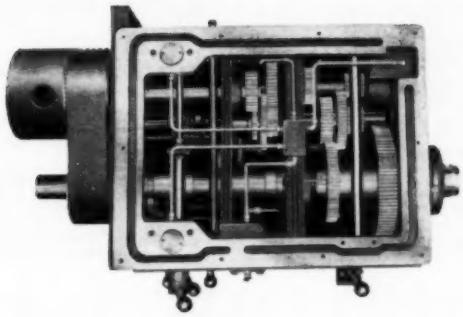


announcing . . . the

13" LeBlond precision



1. *27 spindle speeds easily chosen by direct-reading color plate*
2. *Combination gear-belt drive headstock*
3. *Totally enclosed quick change box; 60 feeds and threads*
4. *Single-lever 4-way power rapid traverse*
5. *Chip pan slides in grooves; easy clean out*
6. *One-piece totally enclosed apron; ample carriage bearing surface*
7. *Rigidly ribbed bed with hardened and ground steel ways*
8. *2-speed thrust-lock tailstock with quick-set length dial*
9. *Apron controlled leadscrew reverse*



new
toolroom lathe

combination gear-belt headstock

The headstock of the new LeBlond 13″ Precision Toolroom Lathe incorporates combination gear-belt drive, delivers 27 speeds ranging from 18 to 2250 rpm. A timing-type non-slip belt is used for the nine high speeds; lower speeds are gear-driven. A color index plate makes speed selection easy for the operator. A constant speed motor supplies up to 20 h.p. to the gear train through an electric clutch and brake (standard equipment).

adjustments for starting, stopping, jogging

Heavy work pieces are brought up to speed safely with rheostatic controls to the electric clutch and brake. Torque applied for the first six seconds is adjustable to any percentage of full torque. Similar adjustments for stopping and jogging.

high-speed spindle mounting

Front and center bearings are Timkens in cone-adjusted mountings. The center bearing cup is mounted in a special high speed precision adapter which relieves potential excessive preload—resulting from the inevitable heat of high-speed operation. Front and center mountings are thrust bearings. The original factory-set preload can handle both high and low speeds—no need to reset bearing adjustments in the field.

spur gear design

Minimizes no-load horsepower. Only gears for a specific speed are engaged. Spur gears are fine pitched and wide to give better tooth action and great load carrying capacity. Short, heavy shafts minimize deflection, are mounted on anti-friction bearings. Spindle is completely ground, nose is hardened. Taper nose key drive is positive, simplifies set-up. Provision for multiple-start threads is made with a large easy-to-read dial at the rear of the spindle. A forced feed system lubricates every moving part in the headstock with filtered oil.

other models available

In addition to the new 13″ Toolroom, a new 13″ LeBlond Heavy Duty Lathe is also available. Both can be obtained in plain bed gap models. See your LeBlond Distributor or write today for complete details. Ask for Bulletin T103A (toolroom) or Bulletin HD103A (heavy duty).

...cut with confidence

THE R. K. LEBLOND MACHINE TOOL COMPANY

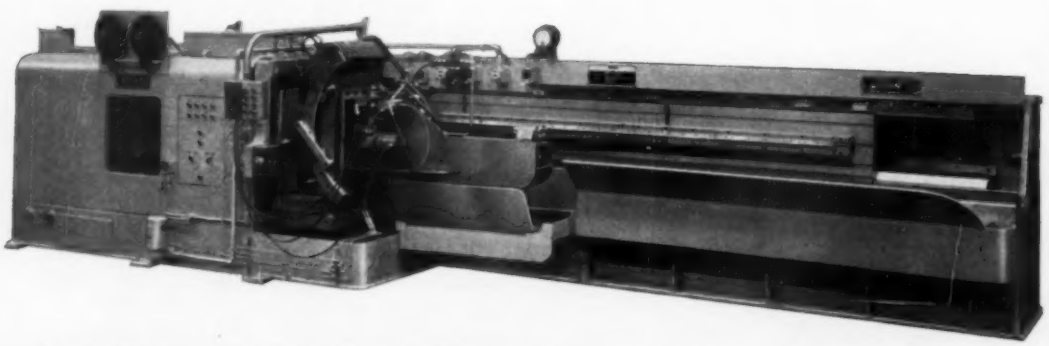
Cincinnati 8, Ohio

LeBLOND of Cincinnati

World's Largest Builder of a Complete Line of Lathes for More Than 71 Years

Closeup of precision indexing fixture and tail support, accommodating wheels from 7" to 12" diameter. The in-and-out fixture table is hydraulically operated.

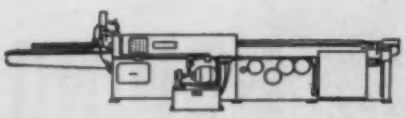
Producing an exceptionally fine finish, and **broaching 45 intricate slots per hour,** the LAPOINTE **SRHE BROACHING MACHINE** accomplishes this **without a single reject.** Here, indeed, is perfection in precision-broaching!



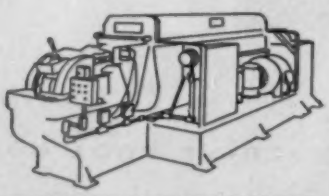
This LAPOINTE Broaching Machine was shipped out of the country to an internationally known manufacturer of electrical equipment. Built with 150-inch stroke, 30 hp., electro-mechanical drive, it is designed to operate at infinitely variable broaching speeds from 5 to 70 feet-per-minute.

The optimum broaching speed for this particular job was found to be 12 fpm. With a return speed of 110 fpm., it broaches the small wheels in 50 minutes and the large wheels in 105 minutes. This is floor-to-floor time, which includes 15 minutes to load and unload. Lapointe Broaching Machines in this series can be built with broaching speeds up to 300 feet-per-minute.

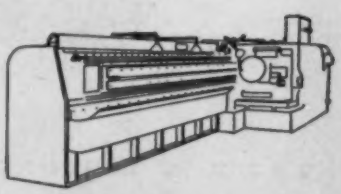
Lapointe-built Broaching Machines are available in hydraulic and electro-mechanical drives.



60" STROKE HORIZONTAL, ELECTRIC



CH CONTINUOUS BROACHING, ELECTRIC



SRHE SINGLE RAM HORIZONTAL, ELECTRIC

You can't run any risk of spoilage when you're working on such a costly part . . . the wheel and shaft being an *integral forging*. "Pine-tree" slots, requiring extremely close tolerances, are broached in the periphery of the wheel which is used in a stationary gas turbine application.

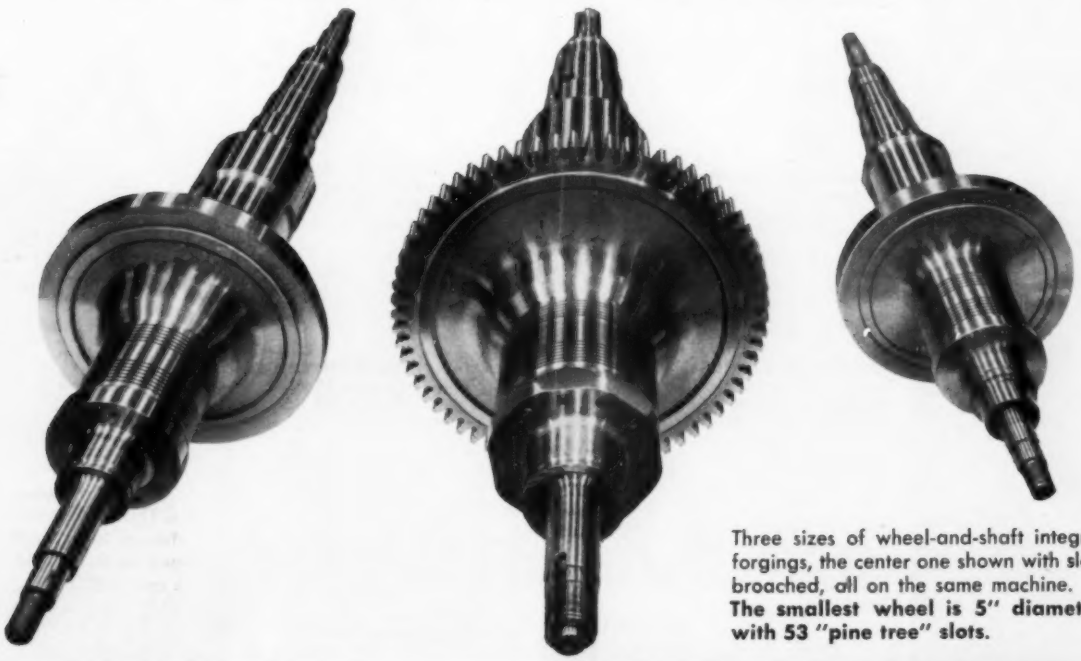
What's the secret behind the outstanding success of this broaching job? . . . Low speed, chatterless broaching on the Lapointe Broaching Machine *with the famous Lapointe pulsation-free electro-mechanical drive.*

If you are machining repetitive forms by milling, shaping, planing, grinding or some other conventional method, it will be to your advantage to investigate the time-saving and cost-reducing results obtainable by converting to Lapointe Broaching. A qualified Lapointe Field Engineer will gladly call on you, on request.

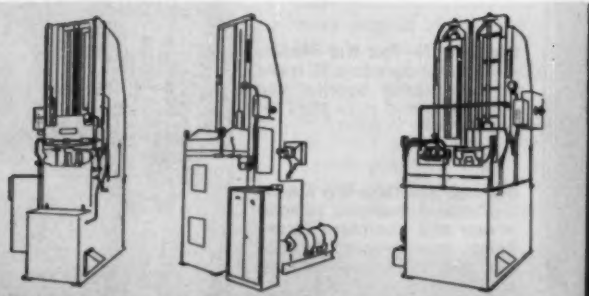
THE LAPOINTE MACHINE TOOL COMPANY

HUDSON, MASSACHUSETTS • U.S.A. *In England: Watford, Hertfordshire*

THE WORLD'S OLDEST AND LARGEST MANUFACTURERS OF BROACHING MACHINES AND BROACHES



Three sizes of wheel-and-shaft integral forgings, the center one shown with slots broached, all on the same machine. **The smallest wheel is 5" diameter with 53 "pine tree" slots.**



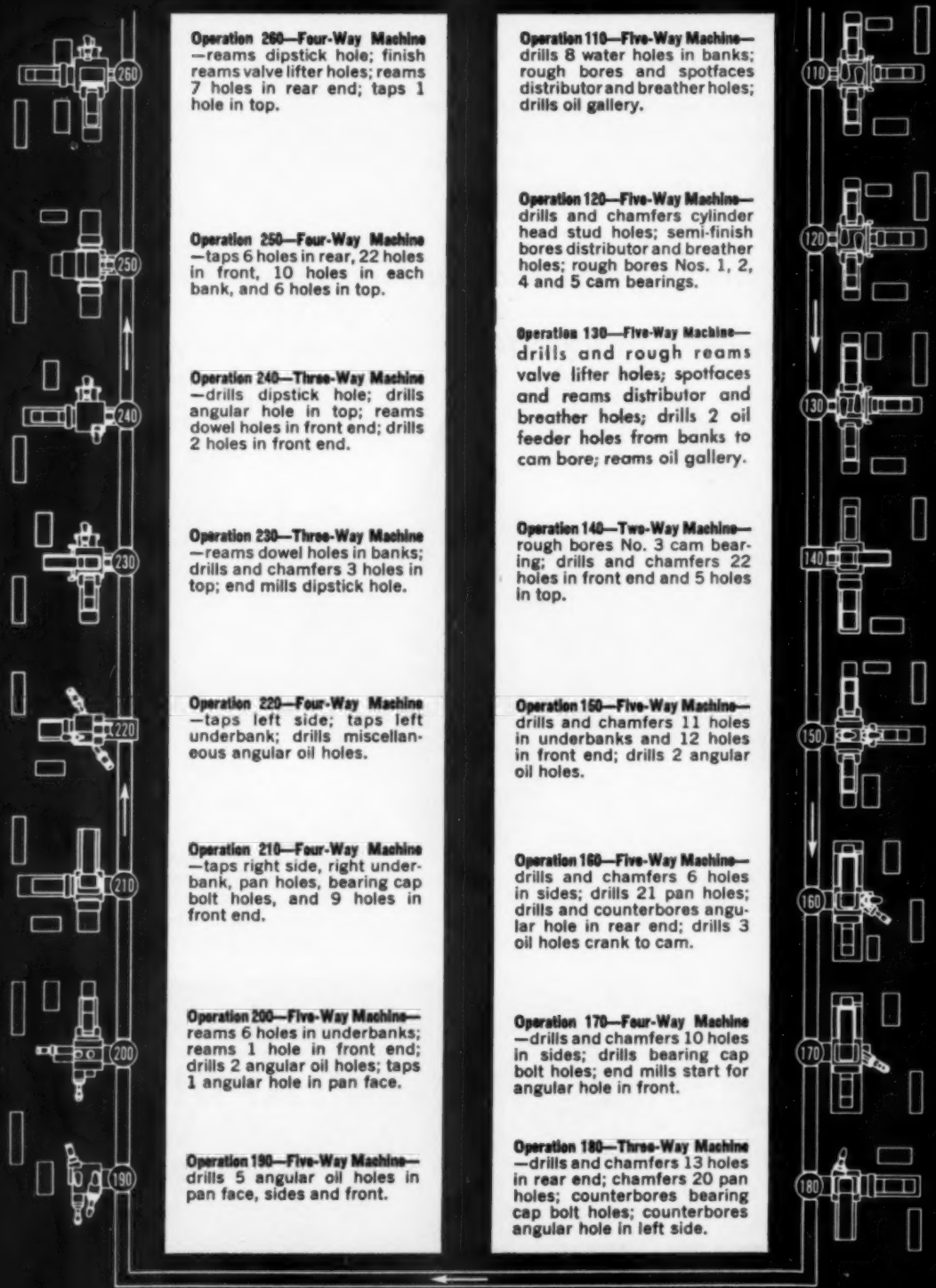
VUE-7 VERTICAL PULL-UP ELECTRIC **SRVE SINGLE RAM VERTICAL, ELECTRIC** **DRVE DOUBLE RAM VERTICAL, ELECTRIC**

LAPOINTE

known to be the best in

BROACHING

Automation for Low Volume Production



Operation 260—Four-Way Machine—reams dipstick hole; finish reams valve lifter holes; reams 7 holes in rear end; taps 1 hole in top.

Operation 250—Four-Way Machine—taps 6 holes in rear, 22 holes in front, 10 holes in each bank, and 6 holes in top.

Operation 240—Three-Way Machine—drills dipstick hole; drills angular hole in top; reams dowel holes in front end; drills 2 holes in front end.

Operation 230—Three-Way Machine—reams dowel holes in banks; drills and chamfers 3 holes in top; end mills dipstick hole.

Operation 220—Four-Way Machine—taps left side; taps left underbank; drills miscellaneous angular oil holes.

Operation 210—Four-Way Machine—taps right side, right underbank, pan holes, bearing cap bolt holes, and 9 holes in front end.

Operation 200—Five-Way Machine—reams 6 holes in underbanks; reams 1 hole in front end; drills 2 angular oil holes; taps 1 angular hole in pan face.

Operation 190—Five-Way Machine—drills 5 angular oil holes in pan face, sides and front.

Operation 110—Five-Way Machine—drills 8 water holes in banks; rough bores and spotfaces distributor and breather holes; drills oil gallery.

Operation 120—Five-Way Machine—drills and chamfers cylinder head stud holes; semi-finish bores distributor and breather holes; rough bores Nos. 1, 2, 4 and 5 cam bearings.

Operation 130—Five-Way Machine—drills and rough reams valve lifter holes; spotfaces and reams distributor and breather holes; drills 2 oil feeder holes from banks to cam bore; reams oil gallery.

Operation 140—Two-Way Machine—rough bores No. 3 cam bearing; drills and chamfers 22 holes in front end and 5 holes in top.

Operation 150—Five-Way Machine—drills and chamfers 11 holes in underbanks and 12 holes in front end; drills 2 angular oil holes.

Operation 160—Five-Way Machine—drills and chamfers 6 holes in sides; drills 21 pan holes; drills and counterbores angular hole in rear end; drills 3 oil holes crank to cam.

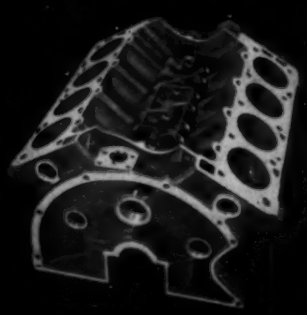
Operation 170—Four-Way Machine—drills and chamfers 10 holes in sides; drills bearing cap bolt holes; end mills start for angular hole in front.

Operation 180—Three-Way Machine—drills and chamfers 13 holes in rear end; chamfers 20 pan holes; counterbores bearing cap bolt holes; counterbores angular hole in left side.

Floor plan of 16 single station machines for processing cylinder blocks

More Specials by Cross

Five-way machine operation 120



Here is a new kind of manufacturing line—one that utilizes automation for low volume production. It machines truck engine blocks at the rate of 15 per hour.

The unique material handling arrangement for the line permits one operator to take care of several of the 16 machines. To load any machine, the operator merely places the part on the turntable, rotates it 90 degrees, moves it about six inches toward the machine and pushes the cycle button. The machine then takes hold of the part, draws it into the work holding fixture, locates and clamps it, performs the machining operation and ejects it back onto the turntable—all automatically.

Other features include: complete interchangeability of all standard and special parts, construction to JIC Standards, hardened and ground ways, hydraulic feed and rapid traverse, and automatic lubrication.

Established 1898

THE CROSS CO.

First in Automation

PARK GROVE STATION • DETROIT 5, MICHIGAN

for management

Some of you have an unnecessary inferiority complex about automation. You think your plant is really too small to enjoy the profits of automated operations.

Actually, it isn't the size of your plant that counts; it's the size of your run which determines how profitable automation can be. Many of our customers are small in square feet, yet they have increased their profits by applying Avey modular automation to all kinds of drilling, tapping, milling, and boring operations.

If you have fairly large runs, don't decide you're too small until you've talked with us about the possibilities. Our proposals might surprise you as being extremely modest. Avey Division, The Motch & Merryweather Machinery Company, Box 1264, Cincinnati 1, Ohio.

It's the size of your run,

for production men

The flexibility of "standard" equipment and the production of "special" are combined in this 62-foot Avey Line-O-Dex machine.

Operations on the jet engine diffuser case include drilling, countersinking, reaming, and lead screw tapping.

One fixture moves both linearly and radially to index the part. Add a second fixture and you double production.

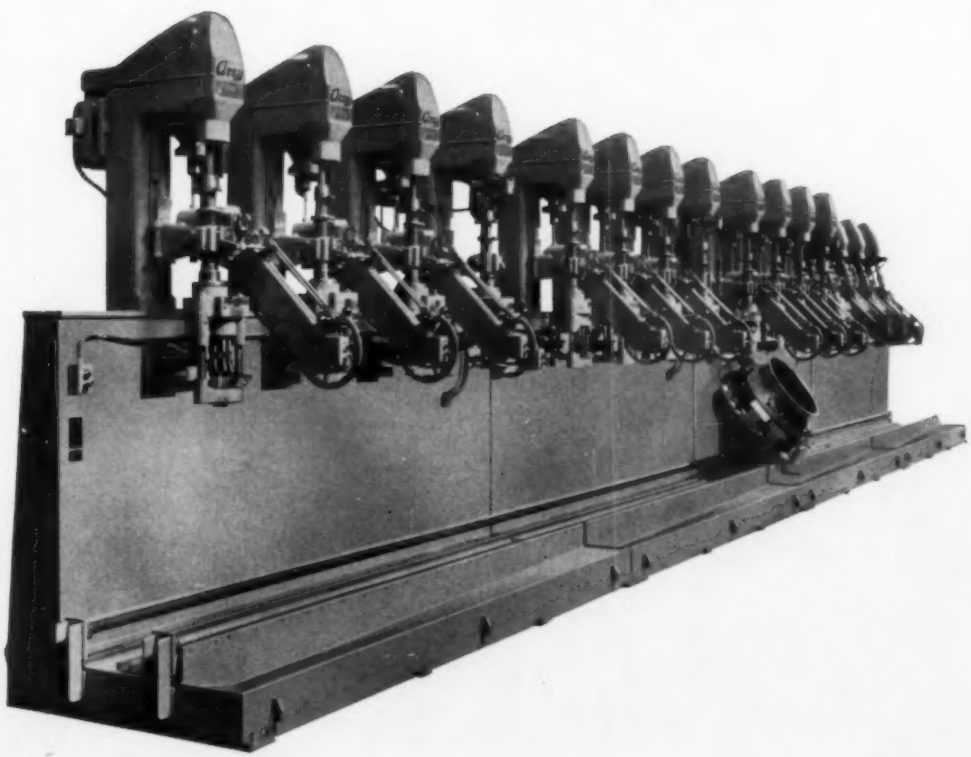
Standard drilling columns are arranged with multiple spindle drill heads which have power feed, four rates of feed, adjustable speeds, and additional head and quill travel to permit easy changeover to a new design.

Transfer mechanism is supported by the base. Another example of Avey's customer-oriented engineering.

Avey

drilling, tapping, production machines

not the size of your plant



Surface systems cut the costs of "fine" carburizing

This manufacturer knows that his Surface carburizing equipment is consistently profitable. His RX® generator gas has a highly uniform analysis. When properly enriched, it gives him the fastest carburizing rate possible. The combination of the most efficient furnace and atmosphere uniformity provide him with maximum carburizing results.

At the same time, the carbon potential of the gas is so easy to control that he can get any surface carbon, case depth, and carbon gradient he wants. Automatic dew point control equipment (Autocarb®) eliminates human error. Carburized work is so clean that little finishing is required.

These advantages apply to every Surface carburizer, whether it's a huge continuous unit in a mass production plant or a small batch furnace in a "job-lot" shop.

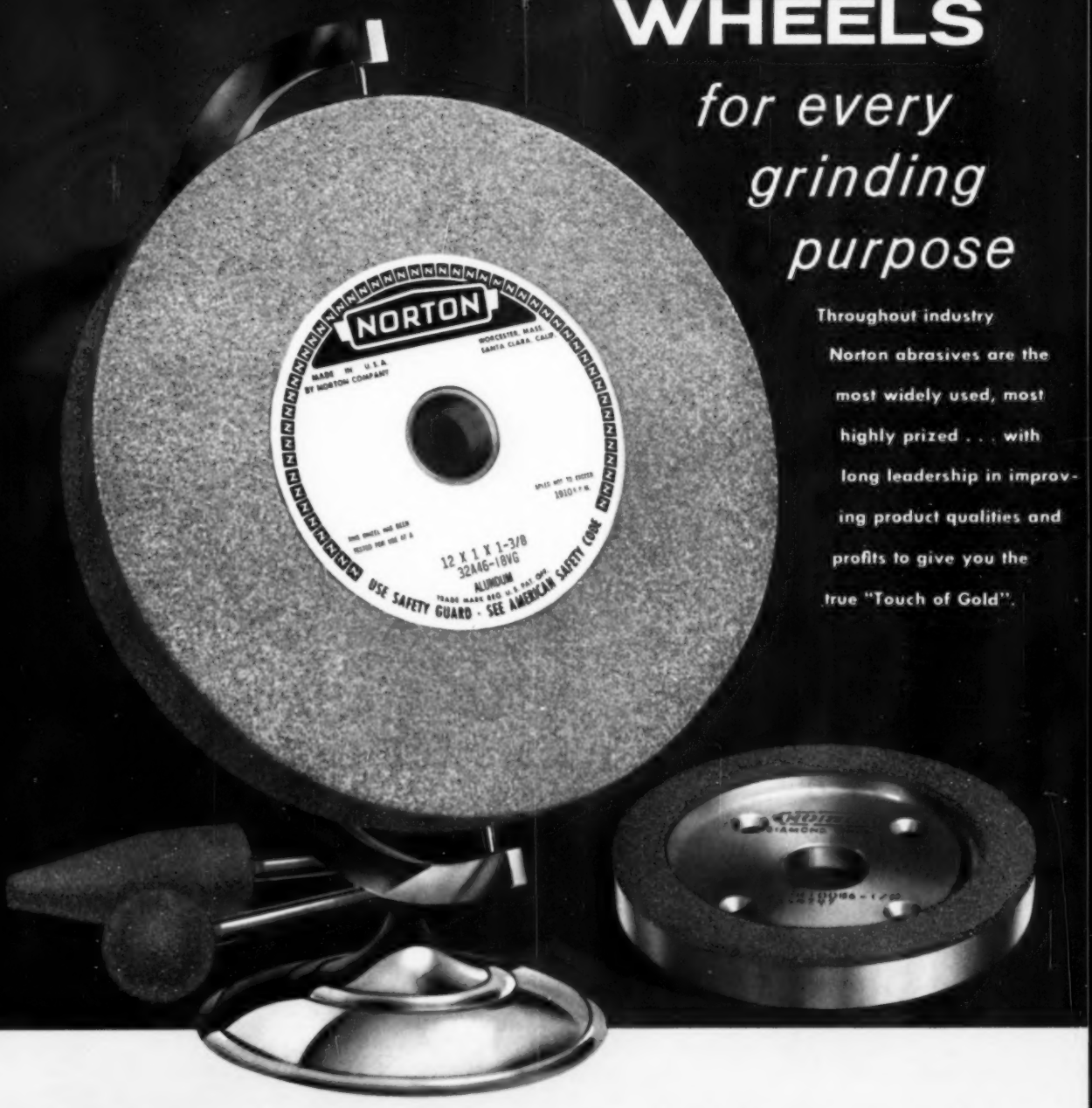
Make your carburizing consistently "fine" and profitable. Write for Bulletin SC-172.

Surface Combustion Corporation, 2365 Dorr Street, Toledo 1, Ohio. In Canada: Surface Industrial Furnaces, Ltd., Toronto, Ontario.

Surface

wherever heat is used in industry

First in the WORLD OF WHEELS *for every grinding purpose*



Throughout industry Norton abrasives are the most widely used, most highly prized . . . with long leadership in improving product qualities and profits to give you the true "Touch of Gold".

Around the world and still expanding

Abrasive and Grinding Wheel Plants — Worcester, Mass.; Santa Clara, Calif.; Hamilton, Ontario; South Africa; England; France; Germany; Italy; Brazil.

Behr-Manning Plants — *Coated Abrasives and Pressure-Sensitive Tapes* — Troy, N.Y.; Canada; Australia; France; Northern Ireland; Argentina; Brazil.

Electric Furnace Plants — Huntsville, Alabama; Chippawa, Ontario; Cap-de-la-Madeleine, Quebec; Brazil.

Grinding and Lapping Machine Plant — Worcester, Mass.

Refractories Plant — Worcester, Mass.

Electro-Chemical Plants — Chippawa, Ontario; Huntsville, Alabama.

Norton Pike Plant — *Sharpening Stones* — *Stair and Floor Tile* — Littleton, New Hampshire.

Bauxite Mines — Bauxite, Arkansas.

General Offices: Norton Company, Worcester, Mass.

Headquarters for the "TOUCH of GOLD"

The world's largest source of abrasive research, manufacturing development, and service . . . all combining to aid your own production with improved grinding at lower cost.

BIG STEPS FORWARD Some of the latest and most important Norton developments—from top to bottom: a 32 ALUNDUM G-bond wheel, providing a unique aluminum oxide abrasive of outstanding performance plus the most advanced vitrified bond ever developed for precision, and semi-precision grinding . . . ALUNDUM TUMBLEX "S" bonded spheres for barrel finishing—spheres that get into areas where other shapes can't reach . . . A 44 ALUNDUM wheel, the most sensational non-premium abrasive ever developed for economical grinding — both rough and precision. Advancements like these are typical of the more than 200,000 different types and sizes of Norton abrasive products that cover every modern grinding job.

SELECTION IN ACTION For ordinary grinding jobs the vast amount of Norton know-how literature tells you how to select exactly the right wheels, while the many Norton films show the best grinding methods. But you may have new, unusual problems. Then, your distributor's Norton factory-trained specialist by studying your jobs can help you find the right solutions in quick time. And if necessary, he'll call in your regional Norton Abrasive Engineer for additional technical advice. With experts like these, the grinding wheels you need will be proved in action—on your machines.

DISCOVERING MUCH MORE Norton laboratory researchers, numbering over 180 scientists and technicians, are constantly seeking to find out a great deal more about abrasives and grinding wheels. Their chief interest is in developing new abrasives, new abrasive products and improved grinding techniques. Their many successes in research of this nature have stepped up grinding progress to lower your grinding costs.

THE RIGHT WHEELS ARE RIGHT AT HAND Your Norton distributor is careful to keep his stocks fully adequate to meet all needs of his area. That's true, too, of the stocks in the five big, strategically located Norton branch warehouses — in the Norton California plant — and of the gigantic stocks at Worcester in "Norton City" — the world's largest grinding wheel plant, Headquarters of the "Touch of Gold."

NORTON
ABRASIVES

Making better products . . . to make your products better

NORTON COMPANY • WORCESTER, MASS.

District Offices: Chicago* • Cleveland* • Detroit* • Hartford • Los Angeles Area (Huntington Park) • New York Area (Teterboro, N.J.) • Philadelphia* • Pittsburgh* • St. Louis

**Warehouse Facilities and Stocks at this location*

Plants and distributors around the world

BEHR-MANNING CO., Troy, N.Y. is a division of Norton Company

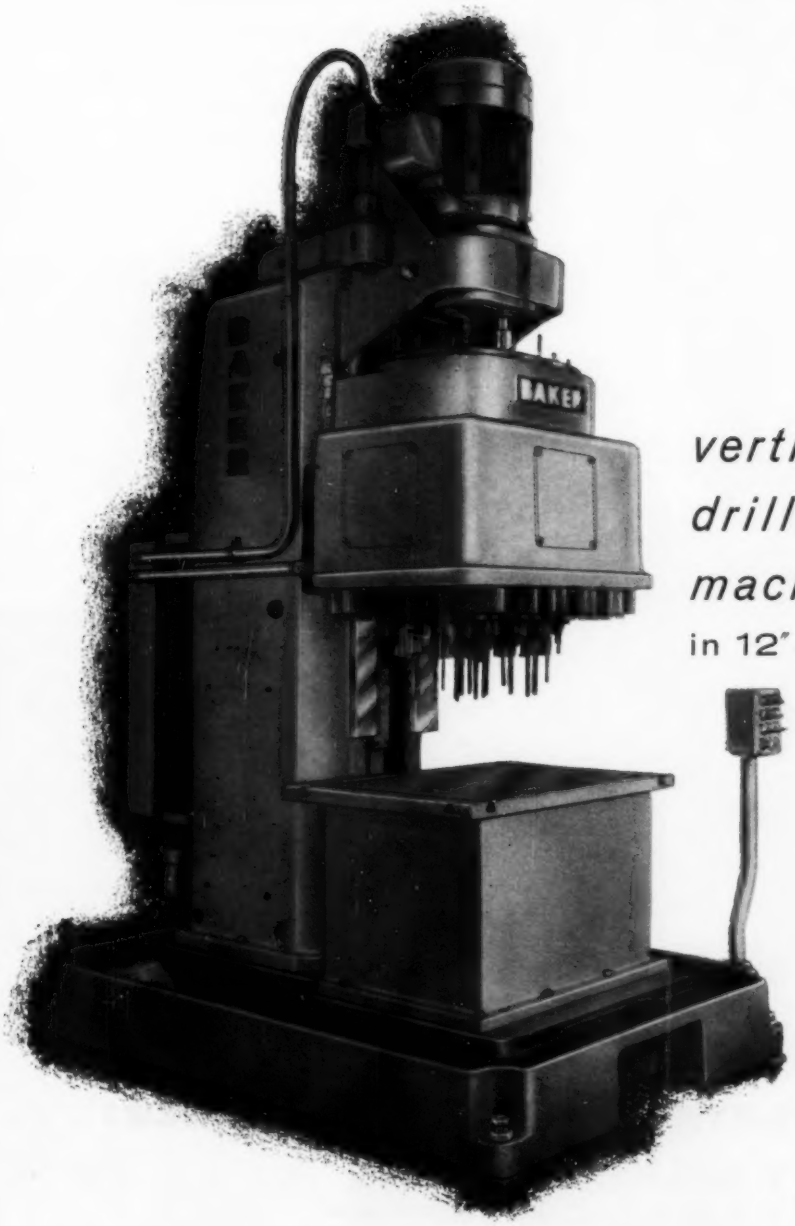
NORTON PRODUCTS
Abrasives • Grinding Wheels
Grinding Machines • Refractories
Electrochemicals

BEHR-MANNING DIVISION
Coated Abrasives • Sharpening Stones
Pressure-Sensitive Tapes

4-58

new!

BAKER™



vertical hydraulic drilling and tapping machines

in 12″ - 18″ - 24″ way widths

BAKER BROTHERS, INC. TOLEDO 10, OHIO

CIRCLE 190 READER SERVICE CARD

BAKER

NEW Baker Vertical and Horizontal Drilling and Tapping Machines are the *most versatile* machines available today. Fixed and adjustable heads, along with other standard components, can be added to these standard basic machines. Complete flexibility permits accomplishing any production drilling or tapping operation. Designed for years of precision work with minimum maintenance, reduced stocking and low-cost retooling. New catalog just off the press . . . send for it and the name of BAKER representative nearest you.

Basic Standard Vertical Machine

NOW . . . COMPLETELY INTERCHANGEABLE!

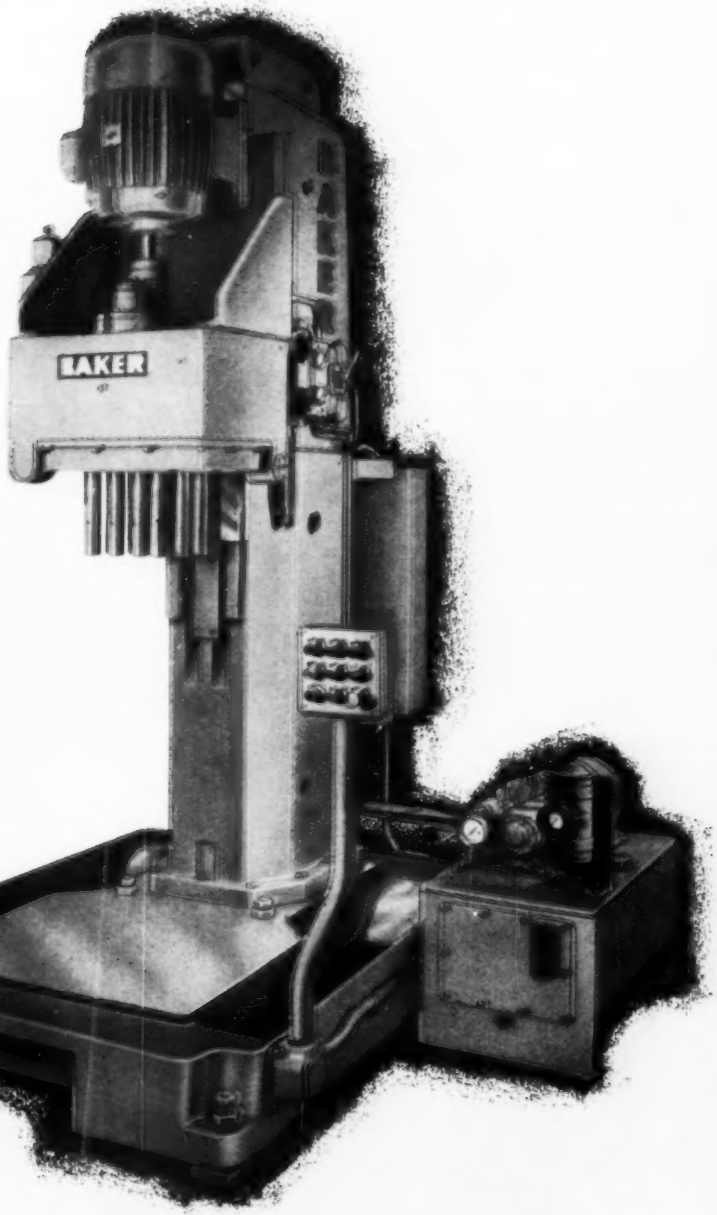
To Fit 3 Sizes **Vertical** Machines

- 21 Adjustable Spindle Heads
- 27 Fixed Spindle Heads
- 3 Types Standard Tables

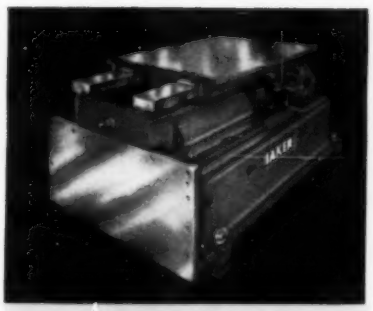
To Fit 3 Sizes **Horizontal** Machines

CIRCLE 191 READER SERVICE CARD

BAKER



Basic Standard Vertical Machine
With Fixed Center Head



Basic Horizontal Hydraulic Unit

Basic Horizontal Feed Machine
With Standard Fixed Head

NEW HORIZONTAL HYDRAULIC FEED UNITS, TOO!

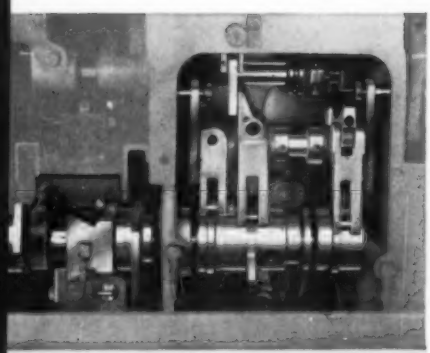
Basic Horizontal Feed Machine
With Standard Adjustable Head

BAKER BROS., INC.
TOLEDO 10, OHIO

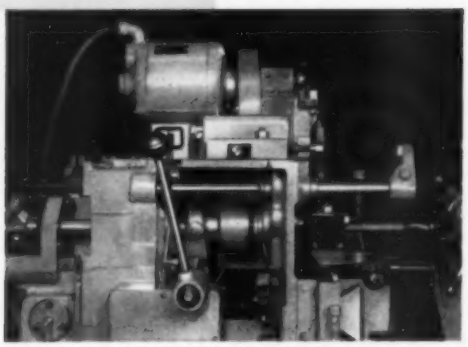
CIRCLE 192 READER SERVICE CARD

BAKER

AUTOMATIC BAR MACHINE



DESIGNED FOR FAST SET-UP AND MAXIMUM CONTINUOUS PRODUCTION—Slide and attachment cams (above) are quickly mounted on sliding shaft, lock securely in position. Below: Slides have micrometer adjustment, are readily accessible to simplify machine operation.



A NEW ADDITION TO THE BAKER LINE

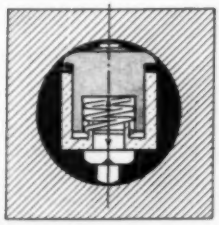
The Baker Automatic Bar Machine overcomes traditional limitations in spindle speed and parts length. This standard ¾"-capacity machine permits high-speed machining of parts up to 18½" long without "trick" tooling. A dependable, instant-reversing transmission allows different spindle speeds for six different cutting operations, with speeds in any cycle infinitely selectable up to 7200 RPM. Revolutionary unit construction ends obsolescence, slashes maintenance cost and downtime. The Baker Automatic Bar Machine is available *now* to expand your production.

BAKER BROTHERS, INC.
TOLEDO 10, OHIO

CIRCLE 193 READER SERVICE CARD

Precision Requires Special Treatment

...AND GETS IT WITH FEDERAL DIAL GAGES!



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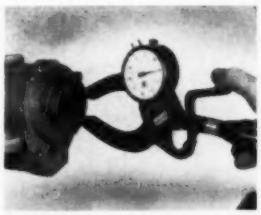

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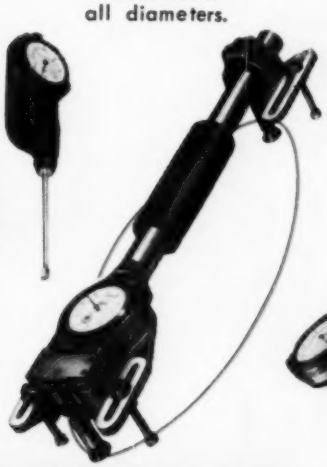

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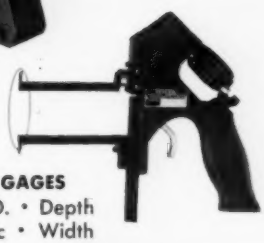

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If you are not kidding yourself about Precision you know you have to gage a dimension a certain way if you want an accurate measurement.

That's why good gage users know that just *any* gage is *not* good enough. And that is why Federal makes so many different types of gages of the same general kind.

There are all degrees of accuracy required and Federal takes the care to obtain that accuracy.

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It's easy to find the gage you need — get in touch with us. Do it now.

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Whatever You Need in Gages —
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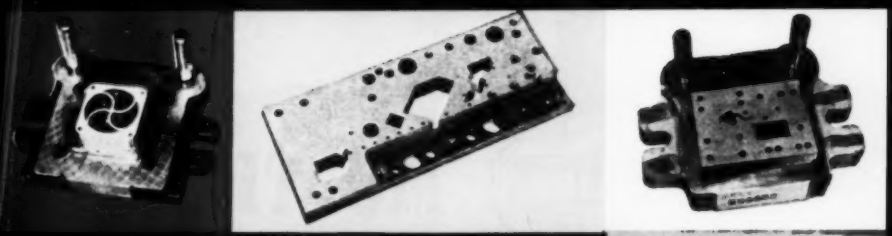
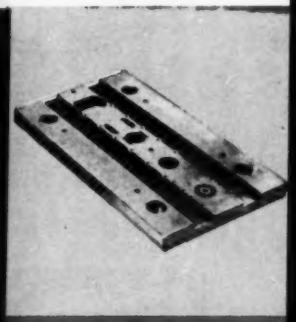
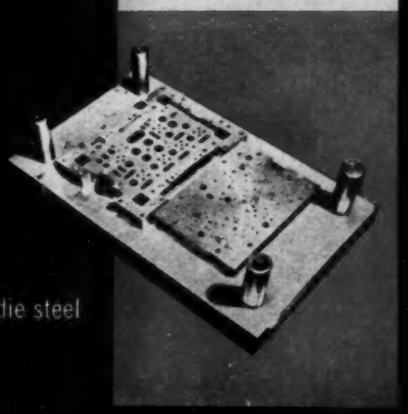
CIRCLE 195 READER SERVICE CARD

CIRCLE 196 READER SERVICE CARD ►







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is widely recognized as a leader in freedom from size change and distortion. No other steel has such a job-proved record of succeeding where other grades have failed. VEGA was specially developed by Carpenter to combine toughness and the machining properties of an oil-hardening steel with the safety in hardening of an air-hardening grade. We'll gladly prove the facts. Call your local Carpenter SERVICE-CENTER. Complete stocks assure you immediate delivery

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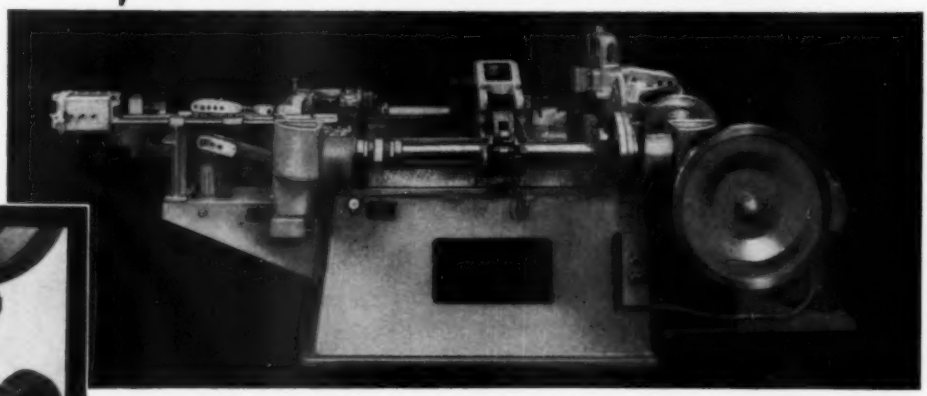
MULTI-SLIDE® MACHINES
/ Reduce Pressroom Costs



Model #35 U. S. Multi-Slide Machine in which 4 die heads (rams) can be used simultaneously.

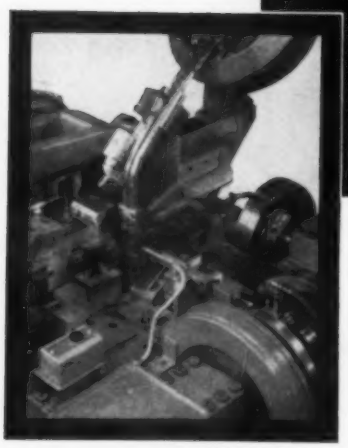


FIGURE 1A

The versatility of the U. S. Multi-Slide for the production of stampings, or assemblies which include stampings, enables you to reduce piece part costs by eliminating expensive secondary operations.

The various movements obtainable with the standard machine equipment allow for automatic production of intricately formed stampings—complete in one operation. Then, a variety of auxiliary attachments, available for use in conjunction with the standard movements, make it possible to go further and fabricate many different types of assemblies—**in the machine —a completed assembly at each cycle.**

Ask for a copy of Bulletin # 15 (A) or, to compare manufacturing costs send in samples or drawings of the part you want to produce.

FIGURE 1

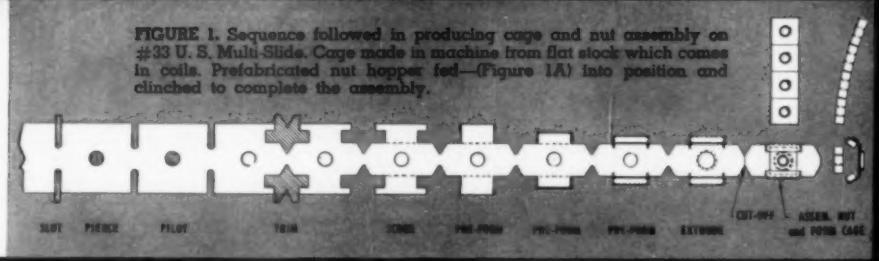


FIGURE 1. Sequence followed in producing cage and nut assembly on #33 U. S. Multi-Slide. Cage made in machine from flat stock which comes in coils. Prefabricated nut hopper fed—(Figure 1A) into position and clinched to complete the assembly.

FIGURE 2

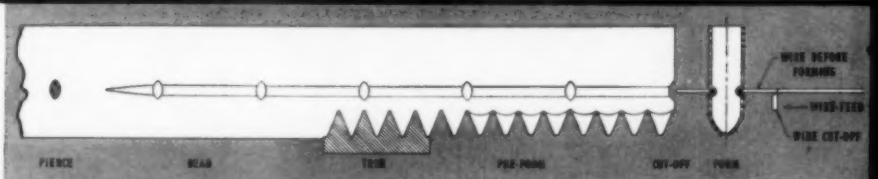


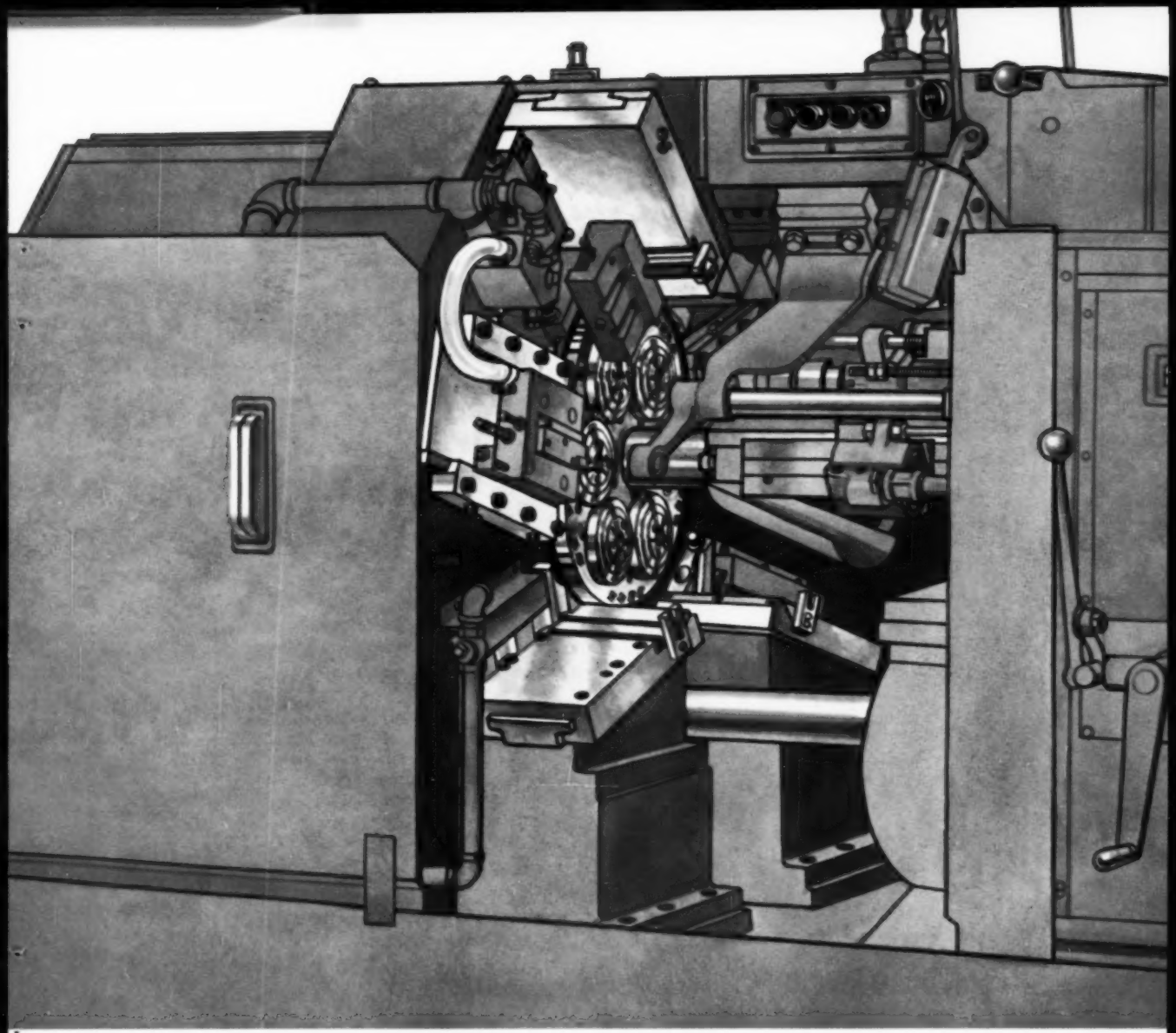
FIGURE 2. Tube reinforcement consists of a flat stock stamping and a wire part—both produced and assembled in a #35 U. S. Multi-Slide. Flat stock progressed from left to right and wire from right to left as indicated. Assembly completed in final forming position.

PRODUCTS

U. S. TOOL COMPANY, INC.

AMPERE (EAST ORANGE) NEW JERSEY

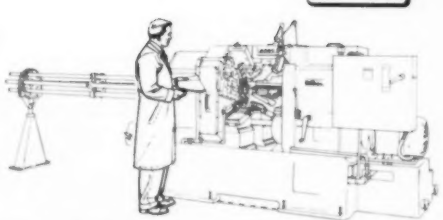
U. S. Multi-Slides® • U. S. Multi-Sliders® • U. S. Automatic Press Room Equipment • U. S. Die Sets and Accessories



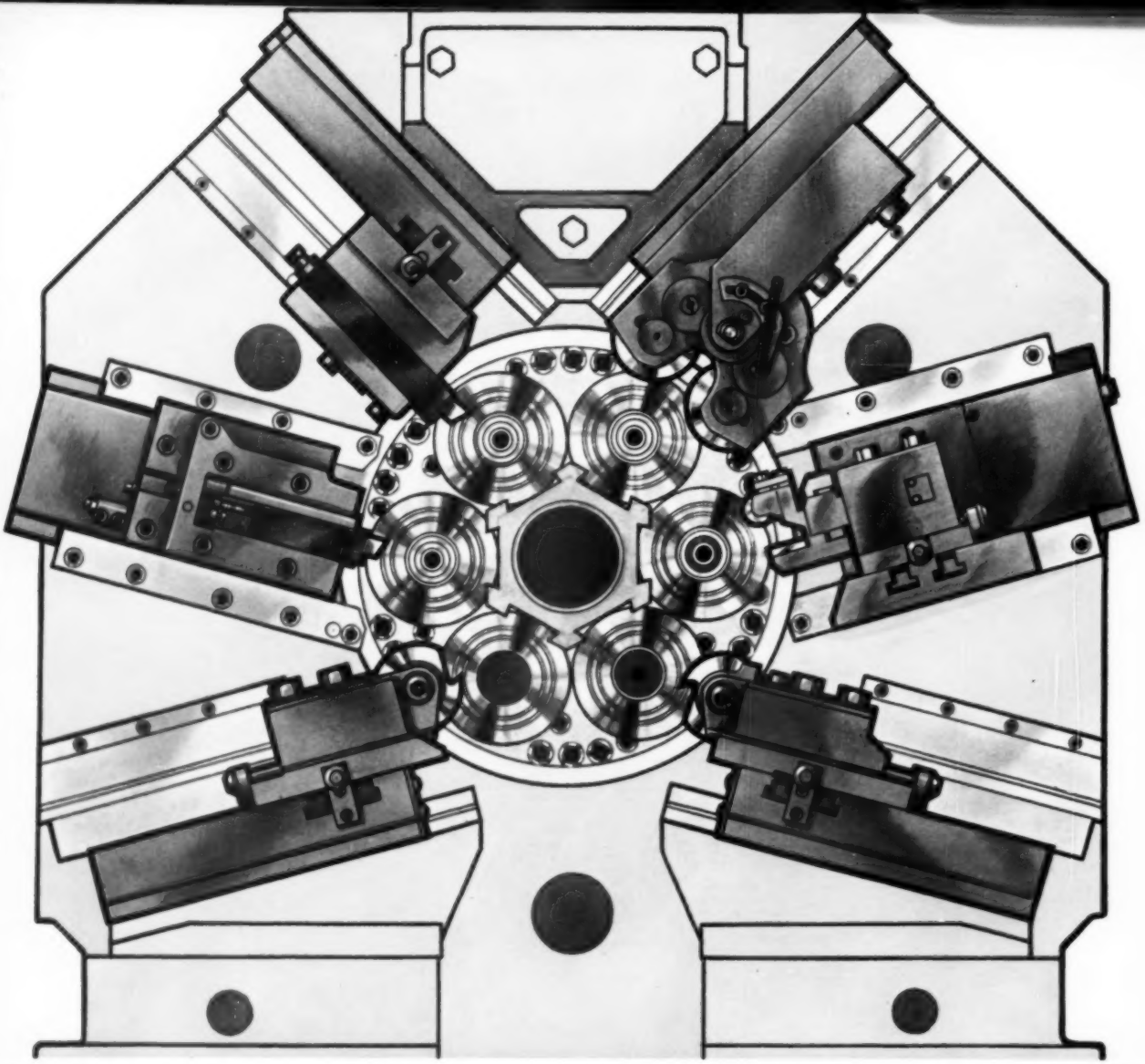
for New Britain accuracy in the 1" and 1¼" range

The new Model 52 gives you every feature of the most modern bar machine design.

Six independent radially-operated cross slides · Spindle speed range of 271-4249 r.p.m. · Spherical roller collet closing mechanism · Automatic stop · More efficient spindle spacing · Greater tooling area accessibility · Positive locating and locking of spindle carrier · Wear-preventing spindle carrier lifting mechanism. Turn the page for more information. The New Britain Machine Company, New Britain-Gridley Machine Division, New Britain, Connecticut.



MODEL **52** NEW BRITAIN AUTOMATIC BAR MACHINE



more operations with a cross slide in every position

The New Britain 52-62 Series automatic bar machines offer you the advantages of a cross slide for every spindle, permitting practically unlimited tooling combinations. Completely independent of each other, and solidly mounted on the frame of the machine, these six cross slides permit more operations on a single machine with simpler tools and attachments. The readily accessible cross-slide cams permit more rapid change-over, too. The New Britain Machine Company, New Britain-Gridley Machine Division, New Britain, Connecticut.

MODEL **62** NEW BRITAIN AUTOMATIC BAR MACHINE
1⅝" and 2¼"

3 OR 30,000 PIECES

Cut them off MORE ACCURATELY at LOWER COST and FASTER on a MARVEL Hack Saw

1. Accuracy? 2. Speed? 3. Low Cost?

Which is most important in your production or intermittent cutting-off operations? *You get all 3* when your work is handled on a MARVEL Series 6A or 9A Heavy Duty Ball Bearing Hack Saw. Whether you're cutting 3 or 30,000 identical pieces, you can be certain that each piece will be true . . . that it will be cut-off quickly, and at the lowest possible tool cost

MARVEL Hack Saws are fine machine tools, with all the built-in accuracy this description implies. Designed to operate at higher speeds, with the heaviest feed pressures, they have almost unlimited power and stamina to stand up to the most severe service.

MARVEL Hack Saws are truly multi-purpose cutting-off machines. *No* run is too short or too long, *no* material too mild or too tough to be accurately and efficiently cut-off on a MARVEL Hack Saw.

Catalog C56 has complete details, facts and figures on MARVEL Metal Cutting Saws. Write for it today.

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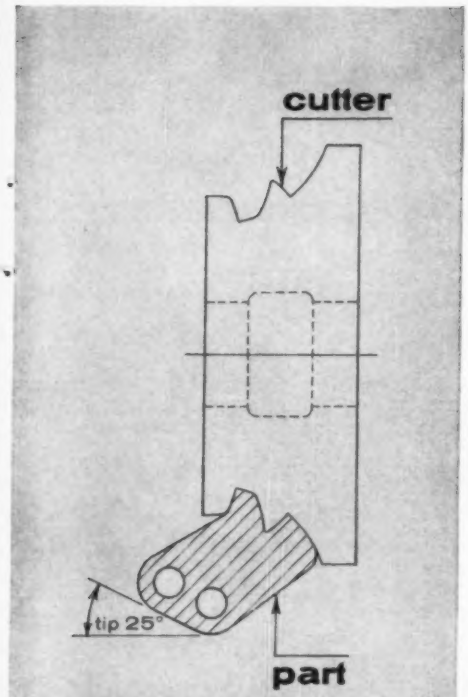
MARVEL Metal Cutting SAWS
Better Machines–Better Blades

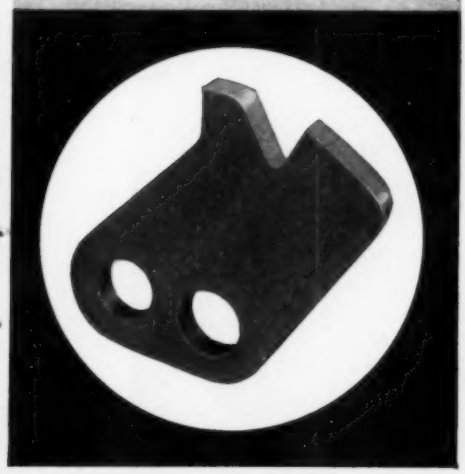
top cutter design
saves 50% in cutter cost,
reduces cutter breakage

BARBER-COLMAN
recommends:

a single solid form relieved cutter to replace two former cutters

improved design to increase tool life and reduce cutter breakage





This Barber-Colman unground form-relieved milling cutter takes the place of two milling cutters formerly operated as a gang for milling these lever sectors. The proportions of the cutter were improved by reducing the cutter diameter and increasing the bore diameter. These improved proportions provide greater rigidity in the cutter and in the milling operation. As a result, initial cutter cost has been reduced 50%, and cutter cost-per-piece further reduced through extended tool life and reduced breakage.

The form on the workpiece is located with respect to the cutter axis to allow sufficient clearance behind all cutting edges. In this particular application, the workpiece is positioned at 25° relative to the cutter axis, permitting the manufacture of a one-piece cutter with adequate cutting clearance.

The material in the part is soft steel of maximum machineability. For best cutting efficiency, the cutter was designed with adequate clearance for milling this material. Cutters are 5″ diameter with 1¼″ bore as compared with previous cutters of 6″ diameter and 1″ bore.

Replacement with a single form relieved cutter has simplified cutter resharpening and reduced cost-per-piece. All Barber-Colman form relieved cutters are index sharpened across the face of the teeth. Cutters are simply and easily resharpened on conventional equipment or Barber-Colman automatic hob and cutter sharpening machines.

With Barber-Colman improved cutter design, pieces are milled at the rate of 3½″ per minute feed, and 150 R.P.M. cutter speed. Tool life averages 3,000 pieces per sharpening.

If you are seeking ways to improve your milling cutter efficiency, consult Barber-Colman cutter engineers. Their skill and experience in applying advance cutter design features will help to solve your milling problems.

BARBER-COLMAN COMPANY

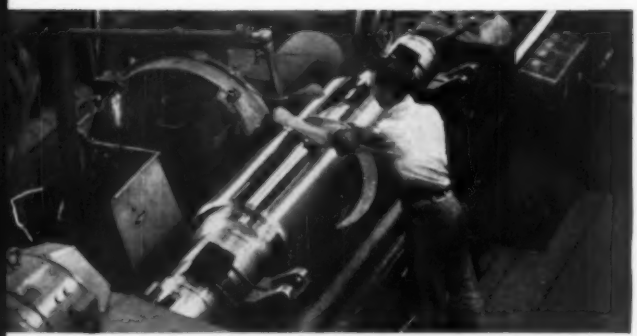
8111 ROCK STREET • ROCKFORD, ILLINOIS

Hobs • Cutters • Reamers • Hobbing Machines • Hob Sharpening Machines

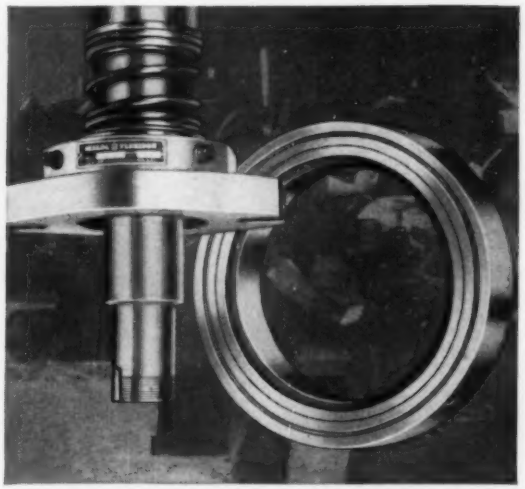
BARBER COLMAN

PROOF OF QUALITY

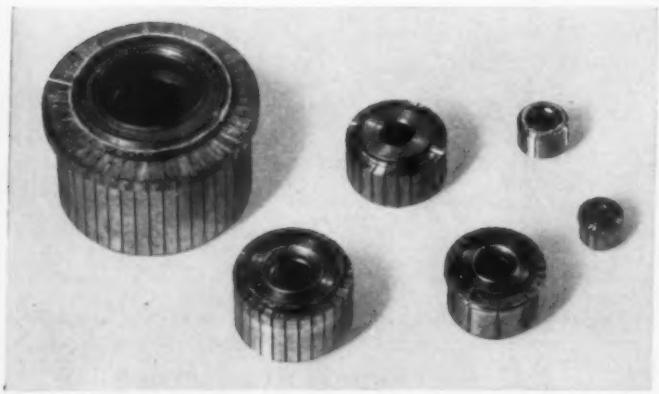
REPUBLIC COLD DRAWN CARBON BARS are used in the manufacture of Shotgun Barrels by Harrington and Richardson, Inc. Mr. Arthur F. Hird, Chief Engineer, states his reasons in a letter reproduced on the opposite page. For information on how Republic Cold Finished Steel may help solve your manufacturing problems, contact your local Republic office or mail coupon.



CHATEAUGAY PIG IRON QUALITY IS PROVED time after time by the superior results achieved in producing giant mill rolls. One such roll is shown being finished to an extremely smooth surface. Other requirements include high strength, wear and heat resistance, and ease of machinability. Chateaugay, Republic's exclusive pig iron fills the bill perfectly. For details on low phosphorus, copper-free Chateaugay, mail coupon.



A LATHE FINISH OF GROUND SURFACE QUALITY is reported by Sealol Corporation, Providence, Rhode Island, in the production of mechanical shaft seals using Republic Free-Machining ENDURO® Stainless Steel Bars. In addition, ENDURO's excellent physical properties overcome shaft wear and attack by corrosive elements. Republic can furnish ENDURO in a complete range of analyses, in the best form to meet your needs. Send coupon for data.



REPUBLIC COLD DRAWN LEADED ALLOY STEELS have helped Han-Kor Inc. of Cleveland, Ohio realize significant tool savings in mass producing electric motor commutators such as those shown above. Because each commutator is simply pressed onto its motor shaft, the center hole in the steel hub must be virtually perfect. Pull broaches used for this operation lasted for only 25,000 pieces when ordinary steel was used. Several years ago Han-Kor switched to leaded steel and, since that time, no broaches have required replacement. Republic Cold Drawn Leaded Alloy and Carbon Steels may provide savings in time and money in your operations. Send coupon for more information.

CIRCLE 203 READER SERVICE CARD

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MANUFACTURERS *Fine Arms* Since 1871

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MASSACHUSETTS
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H & R. ARMS CO., LTD. MONTREAL, CANADA

PLEASANT 7-6341
CABLE ADDRESS HARRICH

January 1958

Republic Steel Corporation
Republic Building
Cleveland 15, Ohio

Gentlemen:

Ever since Harrington & Richardson, Inc., manufacturers of all types of small arms, was organized in 1871, their Metallurgists and Engineers have been experimenting to find the most suitable material for the manufacture of Shotgun Barrels. The steel required had to be of uniform structure and high quality with physical and dimensional stability. It also had to be well suited for machining at higher feeds and speeds, effect longer tool life, produce better surface finish, and provide the higher ultimate strength required by today's high pressure, smokeless powder ammunition.

Manufacturers of Gun Barrels are all too familiar with the specific problems involved. Operations such as Deep-Hole Drilling, Deep-Hole Reaming, Deep-Hole Bore-Burnishing, and Long-Length Turning operations as affecting polishing can make or break a process if such operations are beset by material problems causing high operational costs and excessive rejects.

Republic Cold Drawn Carbon Bars are the answer to the problem. For the past five years Harrington & Richardson, Inc. has been using one and three-sixteenth diameter, cold finished, magnetic tested, stress relieved bars with a maximum of success.

Harrington & Richardson, Inc. has found that the uniformity of structure eliminates hard spots in machining - the bugaboo of surface finish - and produces a barrel of uniform strength capable of withstanding great forces.

The quality of the steel is reflected in the surface finish achieved. Republic Cold Drawn Carbon Bars are relatively free of sub-surface defects and incipient cracks appearing at the final turning and burnish "bore buttoning" operations. Its physical and dimensional stability reduces the need for constant machine adjustments and straightening operations. All of these characteristics combine to reduce rejects to an absolute minimum effecting low operational and material costs.

Republic Steel Corporation can indeed be proud that this material enables Harrington & Richardson, Inc. to offer higher quality firearms to sportsmen at very moderate prices.

Very truly yours,

Arthur F. Hird
Chief Engineer

AFH:em

ALL AGREEMENTS ARE CONTINGENT UPON STRIKES, ACCIDENTS AND OTHER DELAYS UNAVOIDABLE OR BEYOND OUR CONTROL.

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World's Widest Range of Standard Steels and Steel Products

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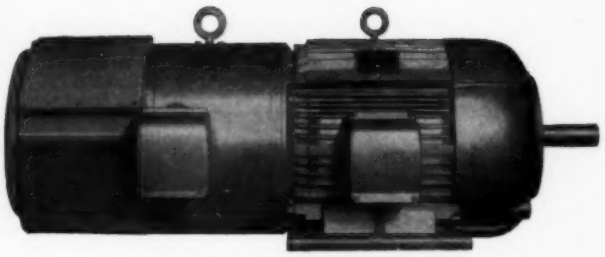
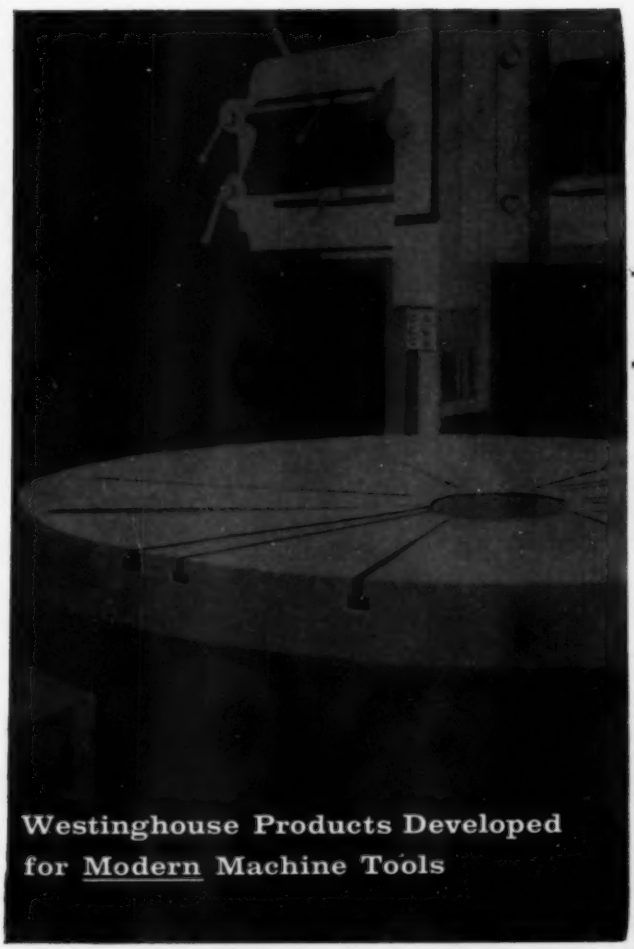
CIRCLE 204 READER SERVICE CARD

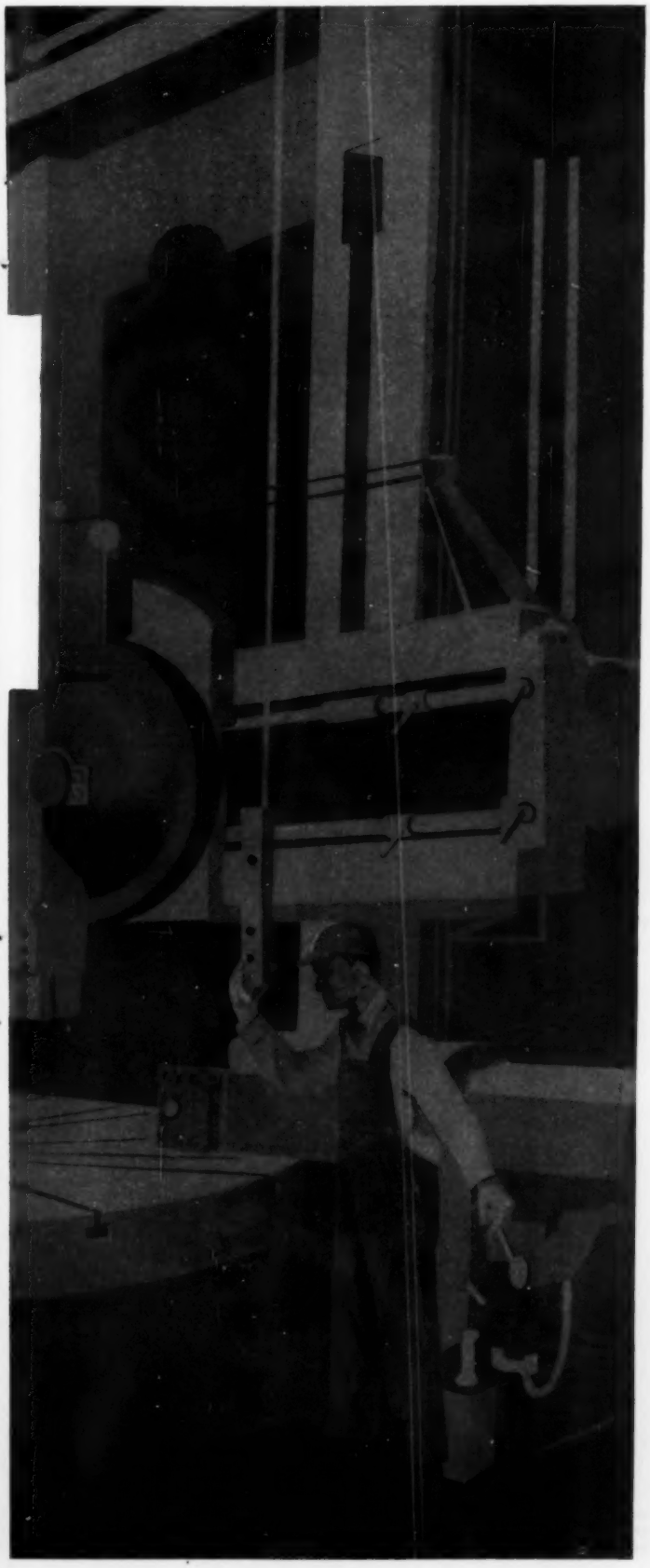
NEW WESTINGHOUSE RECTIFLOW DRIVE



SINGLE, COMPACT UNIT PERMITS ADJUSTABLE SPEEDS DIRECT FROM A-C POWER SOURCE



Westinghouse Products Developed for Modern Machine Tools



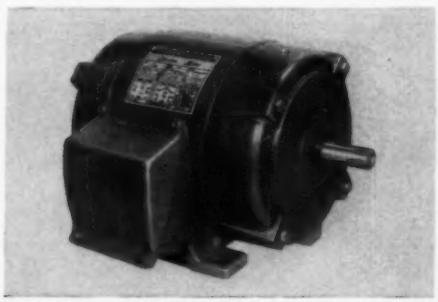
The new Westinghouse Rectiflow* drive gives performance direct from an a-c power source, which was previously obtainable only from a constant-voltage d-c motor with field control.

Completely electrical in a low-maintenance integral unit, Rectiflow is available in constant hp or constant torque, with inherent speed regulation no load to full load of 5 to 10 percent.

Available in TEFC, forced ventilated and dripproof construction, Rectiflow is another example of a Westinghouse product, designed to give the most production at the lowest cost.

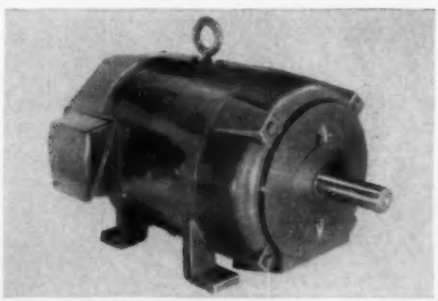
For complete information about Rectiflow drives — and other modern Westinghouse components, ask your Westinghouse Sales Engineer. Or write Westinghouse Electric Corporation, P.D. Box 868, 3 Gateway Center, Pittsburgh 30, Pennsylvania. J-96111

*Trade-Mark



The reliable Westinghouse Life-Line® "A" a-c motor, part of Rectiflow, combines Bondar®, Bondite and Mylar* insulation for long life. Prelubricated, factory-sealed bearings eliminate need for lubrication — keep lubricants in, dirt out.

*DuPont registered trade-mark



The new Westinghouse Life-Line "H" d-c motor, with revolutionary silicone insulation, gives ten times longer insulation life. New compact design gives fastest response of any industrial motor. New modern housing gives top protection and appearance.

YOU CAN BE SURE... IF IT'S

Westinghouse

WATCH "WESTINGHOUSE LUCILLE BALL-DESI ARNAZ SHOWS" CBS TV MONDAYS

IMPELLER WHEEL for Cooper-Bessemer centrifugal gas compressor, built of USS "T-1" Steel because of its high yield strength and weldability. Cooper-Bessemer's Chief Metallurgist, W. R. McCrackin, is shown at left with USS Service Metallurgist, J. M. Trutz.

High yield strength and weldability make (USS) "T-1" Steel the choice for centrifugal compressor impellers

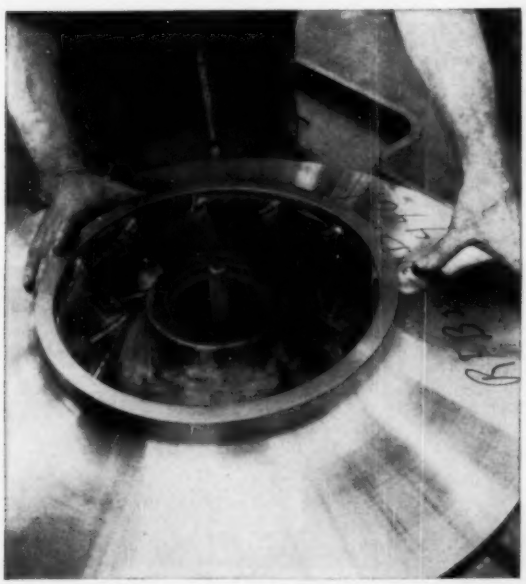
The rotating impeller wheel of a centrifugal gas compressor is subject to great forces. Speed is in the 6,000 rpm range, and the stresses which tend to pull the wheel apart run as high as 75,000 psi in some locations. Since the impeller is fabricated by welding, this application called for a weldable steel with extra-high yield strength. USS "T-1" Steel filled the bill.

The new minimum yield strength of USS "T-1" Constructional Alloy Steel is 100,000 psi (but it can still be furnished to 90,000 psi for code-governed applications). In addition, "T-1" Steel is readily weldable. These two factors led to its selection for the impeller wheels of Cooper-Bessemer centrifugal gas compressors.

The impeller is made of a wheel-shaped blank, forged and then machined to shape. Vanes are welded to this, and another forged, machined disc or shroud is welded over the vanes (see diagram). The entire assembly is then stress relieved at 1100° F. The last operation is an overspeed balance test at 6,000 rpm.

What can USS "T-1" Steel do for you? The additional advantage of high resistance to impact abrasion has made "T-1" Steel the preferred metal for construction and mining equipment. Shovel buckets, truck bodies, scrapers, bins and tanks can all be built bigger, stronger and lighter with USS "T-1" Steel. Write for our latest booklet. United States Steel, 525 William Penn Place, Pittsburgh 30, Pa.

USS and "T-1" are registered trademarks

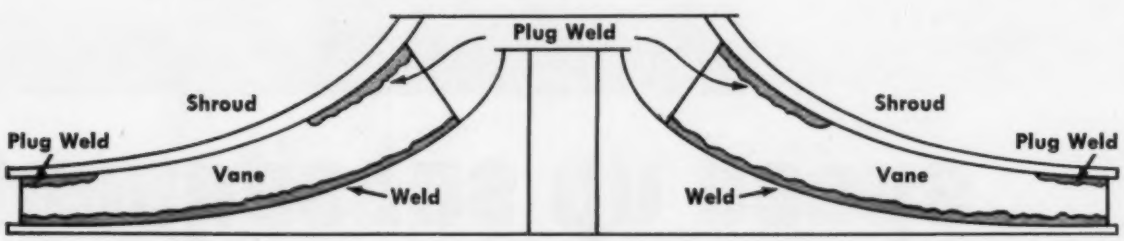


STRONG WELDS. Note the vanes welded to the "T-1" Steel discs. Welds must withstand critical speeds up to 6,000 rpm.

United States Steel Corporation — Pittsburgh
Columbia-Geneva Steel — San Francisco
Tennessee Coal & Iron — Fairfield, Alabama
United States Steel Supply — Steel Service Centers
United States Steel Export Company

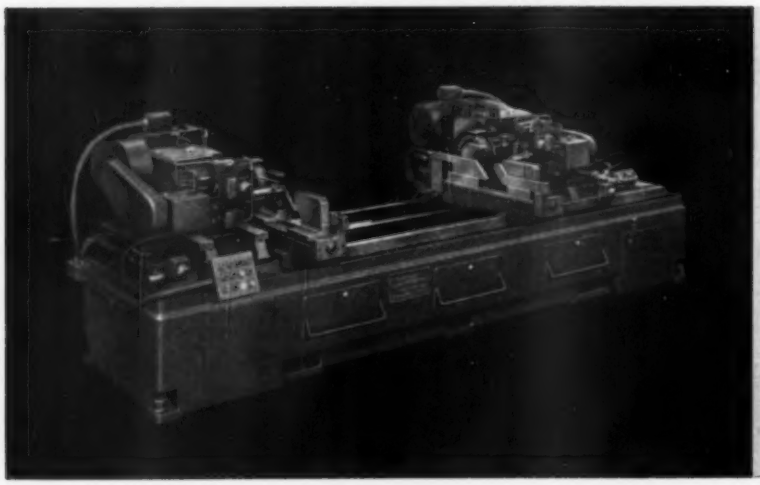
United States Steel

(USS)



Cross section of impeller wheel.

These MOTCH AND MERRYWEATHER precision



MILL & CENTER

Model MC 1648. Incorporates two standard milling heads and two standard drilling heads. Feed rates infinitely variable. Right hand unit is adjustable for varying part lengths. Fixtures are self-equalizing vises. Milling and drilling units, and clamping fixtures are hydraulically actuated and electrically controlled.

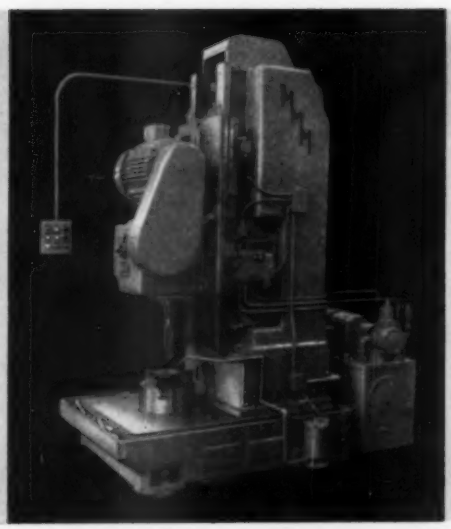
Available in two sizes: 1″ to 6″ diameter; 8″ to 48″ length, with 20 horsepower heads; and 1″ to 4″ diameter; 6″ to 24″ length, with 5 horsepower heads.

cut production costs...

UPRIGHT DRILLING & BORING MACHINE

Model VS 2615. Designed for heavy duty drilling and boring. This machine will accommodate many types of heads, making it adaptable to a wide variety of machining operations. Its standard automatic cycle consists of rapid traverse down, feed, and rapid return. Variations of this automatic cycle are available.

Available with speeds from 30 to 190 RPM, up to 40 horsepower, stroke of either 15″ or 30″, variable hydraulic feed, with maximum pressure of 20,000 pounds.



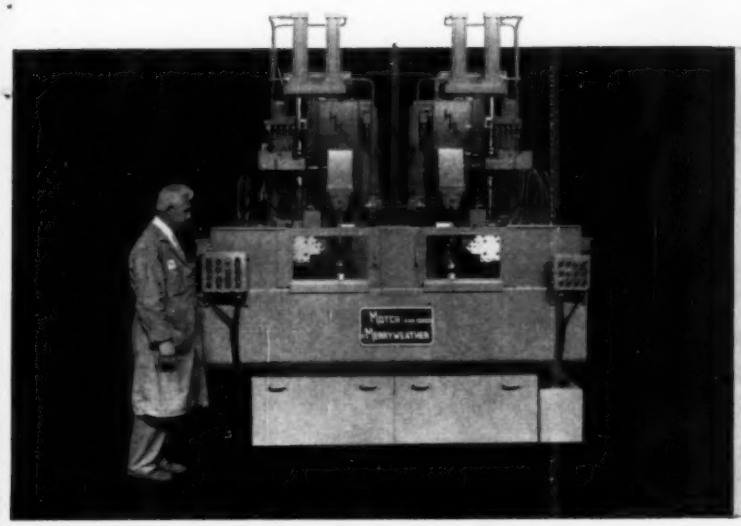
SINGLE END MILL & CENTER

Model SMC. Ideal for tool room or production work. Incorporates standard slide, milling and drilling head, adjustable stock support and stop assembly. Speed of milling and drilling head unit varied by changing easily accessible pulleys and belts. Performing both milling and drilling during one clamping, work is milled square to the center.

Available with diameter from ¾″ to 3½″, length from 4½″ to 48″, and 5 horsepower on the milling head.

speed up subsequent

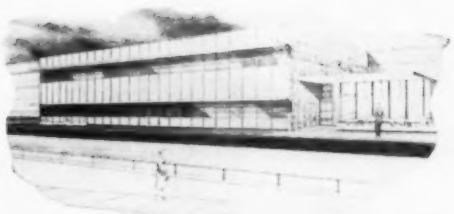
performance machines...



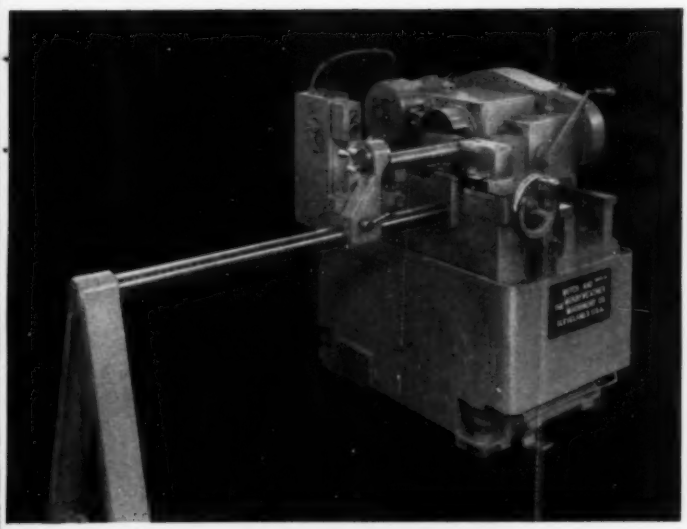
TWO-SPINDLE VERTICAL TURNER

Designed for precision, production-type turning, boring and facing. Two hydraulically-operated, automatically lubricated tool slides are mounted on hardened and ground steel ways with tapered gibs for accurate alignment. Spindle and slide units will operate independently, have separate controls.

Available with 20″ swing; spindle speeds from 20 to 5000 RPM; stroke—horizontal 6″, vertical 12″; and variable hydraulic feed.



Partial view of M&M's expanded Cleveland facilities. Why not visit us at your first opportunity?



operations

• Keeping pace with the increasing need for flexibility in standard metalworking machinery, M&M offers industry these four highly-flexible, readily-adaptable machine tools.

To learn how they can add flexibility —and dependability—to your machining operations call your Motch & Merryweather representative, or write directly to Motch & Merryweather Machinery Company, 1250 E. 222nd St., Cleveland 17, Ohio.

Machine Tool Manufacturing Division
Cutting Tool Manufacturing Division
CLEVELAND
Avey Division, Cincinnati

BUILDERS OF AUTOMATIC PRECISION CUT-OFF, MILLING, TURNING AND DRILLING MACHINERY

How Howard McGlory cut with a hard-sided

Howard F. McGlory is Bay State's special sales engineer for the Pittsburgh and Detroit areas. His job is to add his knowledge and experience to that of the many Bay State Abrasive engineers in these areas. Because of his wide and varied experience in diamond grinding wheel application problems, he has spoken, with authority, to many groups on carbide grinding.

grinding costs at Kennametal diamond grinding wheel...

As one of the nation's top producers of cemented carbide products, Kennametal, Inc., uses a lot of diamond grinding wheels; and considering the expense of diamonds, they cannot be casual about their grinding costs.

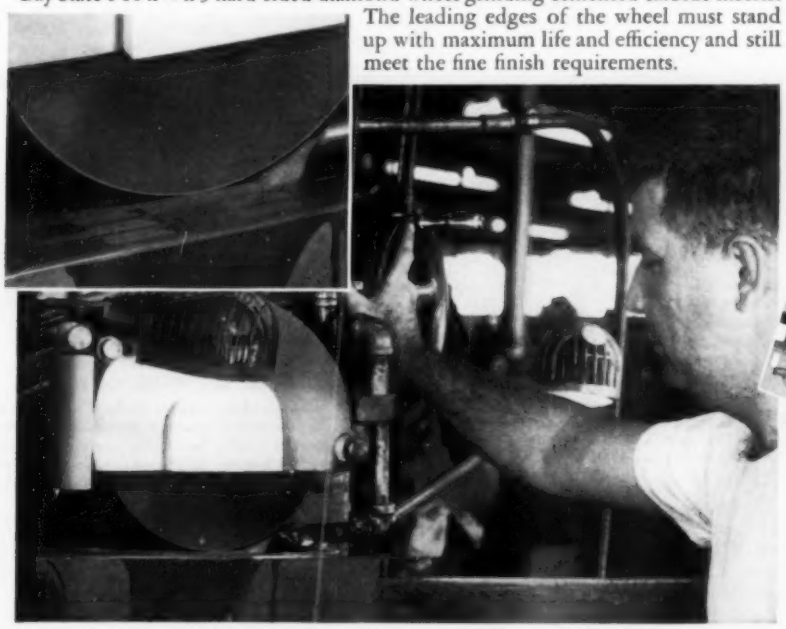
That's just where Bay State's new hard-sided diamond wheel does an outstanding job.

As Bay State's Howard McGlory puts it: "The big problem here was to get extra bond-strength at the edge of the wheel. In this manner, the wheel holds its shape. The corners do not break down faster than the center section." The wheel is unique in that it has a 3/16" hard shell on each side to hold the corners. This was the result of a special modification of Bay State's resinoid bond.

Under regular production conditions, this 10 x ½ x 3 wheel is now helping Kennametal turn out more precision-finished carbide pieces at lower cost than ever before. And it was *lower cost and superior performance,* not claims that sold Kennametal's General Superintendent, F. J. Lennon, who says: "We have just one policy on buying diamond wheels here and it's simply this—every wheel is permanently on test. We will settle for absolutely nothing less than the best at any time."

That policy suits Bay State representatives perfectly. Like Howard McGlory, they are all thoroughly trained abrasive specialists who are willing to work hard to produce convincing results. *Better grinding at lower cost . . . that is their business.*

Bay State's 10 x ½ x 3 hard-sided diamond wheel grinding cemented carbide inserts. The leading edges of the wheel must stand up with maximum life and efficiency and still meet the fine finish requirements.



This 34 page catalog is yours for the asking. It contains a great deal of helpful information, including prices. Send for a copy today.

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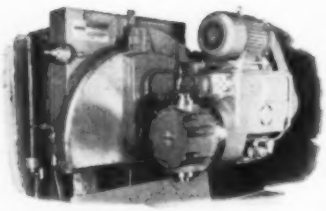
BAY STATE WHEELS of PROGRESS

Bay State Abrasive Products Co., Westboro, Massachusetts.
In Canada: Bay State Abrasive Products Co., (Canada) Ltd., Brantford, Ontario.
Branch Offices: Bristol, Conn., Chicago, Cleveland, Detroit, Pittsburgh. *Distributors:* All principal cities.

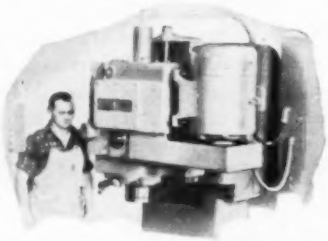
Get the one best milling machine for your job

by starting with elements like these



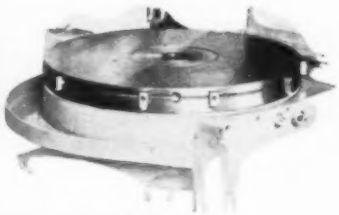
ALL-ANGLE HEADS

In two basic styles and rated up to 30 hp, permit outstanding machining economy by positioning the spindle instead of the work.



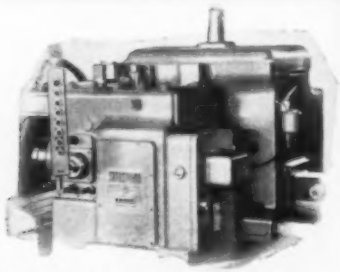
VERTICAL OR HORIZONTAL HEADS

Available in capacities from 3 to 100 hp provide the speeds and horsepowers needed to handle either nonferrous metals or superalloys.



ROTARY TABLES

Are available in a variety of sizes and types for continuous or rotary milling to meet an almost unlimited range of production needs.

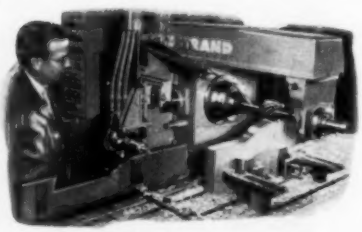


ADJUSTABLE COLUMNS

Provide maximum cutting rigidity for horizontal heads over a wide range for milling both large and small workpieces.

HORIZONTAL TABLES

Available in widths ranging from 10½" to 96" and feed strokes from 18" to 216" permit combining the table sizes and spindle horsepowers that do the job best.



TRACER OR TAPE CONTROL

Basic design elements make it possible for Sundstrand to provide machines with hydraulic tracing for non-ferrous metals, electronic tracing for ferrous metals or tape control for 1 to 5 axis element movement.

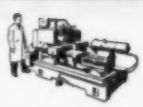
It's a basic principle of Sundstrand Rigidmil design to combine standard elements into machines that give custom built performance.

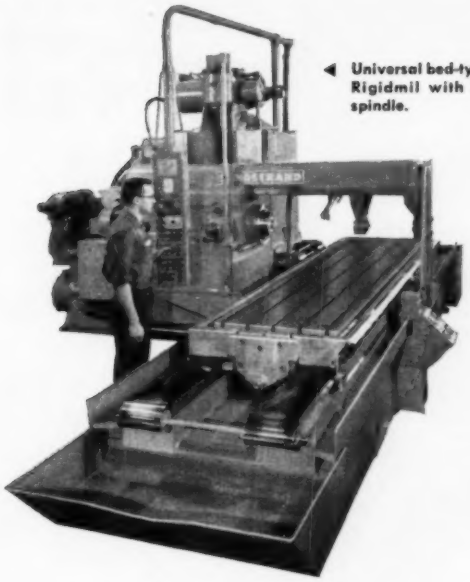
The other important ingredient in putting Sundstrand "Engineered Production" to work on your job is the application of years of manufacturing and machine design experience to your production problems. This know how is behind the determination of the correct tooling for your job and the selection of machine elements needed to complete the machine.

Machines shown on the page at the right are typical of some of the new ideas in milling machines that you get from Sundstrand. From Sundstrand you get precisely the machine you need for the jobs you have to do. No need to compromise quality or performance by buying too little machine — no need to pay for more machine than you need to get the job done.

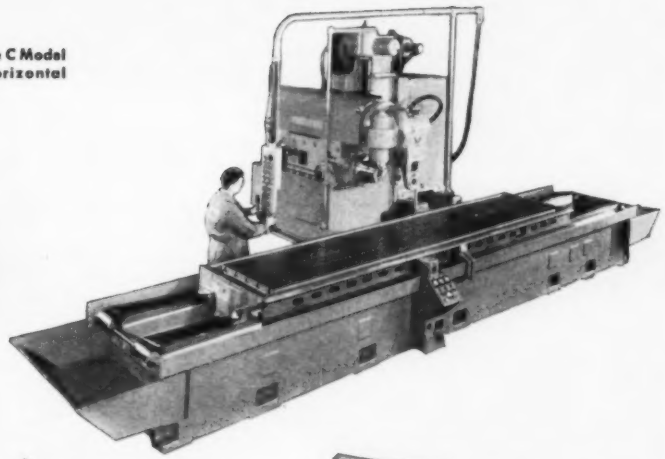
SUNDSTRAND "Engineered Production" Service*

AUTOMATIC LATHES | SIMPLEX RIGIDMILS | DUPLEX RIGIDMILS | TRIPLEX RIGIDMILS | SPECIAL MACHINES

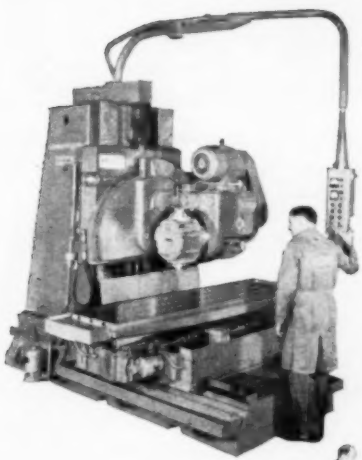




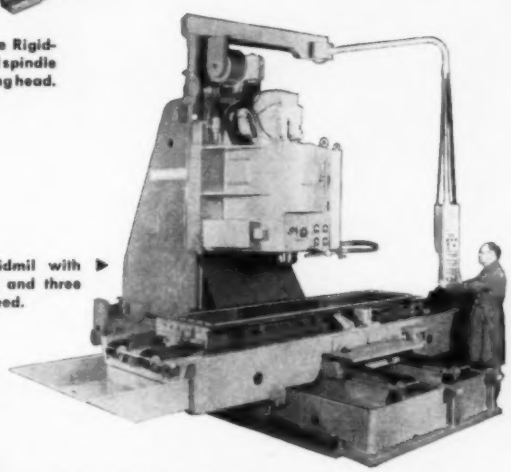
◀ Universal bed-type C Model Rigidmil with horizontal spindle.



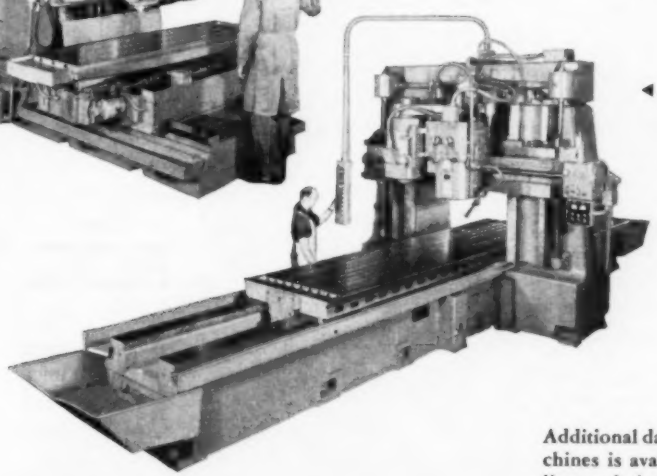
▲ Universal bed type Rigidmil with horizontal spindle and all angle milling head.



◀ Precision five axis machining is provided by new Sundstrand Omnimil.



Vertical Rigidmil with 50 hp head and three directional feed. ▶



◀ Rail type Rigidmil equipped with vertical head controlled from swinging pendant. Machine can be furnished with additional vertical heads, side heads or all-angle head depending on job requirements.

Additional data describing features of Sundstrand milling machines is available in two bulletins describing the C-Model line and the Sundstrand Omnimils. *Ask for Bulletins* 197.

SUNDSTRAND MACHINE TOOL CO.

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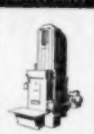
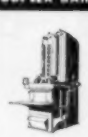
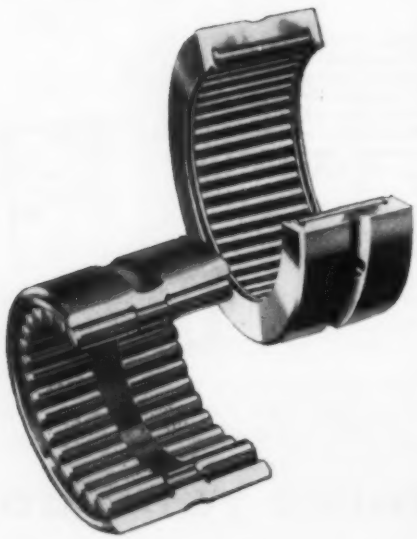
BROACHING TOOLS | THREE WAY | SINGLE RAM | HORIZONTAL | DUPLEX RAM | PRESSES





SUNDSTRAND "Engineered Production" Service"

Bryant CENTALIGN Internal Grinders Increase Bearing Race Production up to 50%



The results obtainable with Bryant CENTALIGN Internal Grinders are illustrated by the case of a well-known manufacturer of precision roller bearings, who recently installed a battery of CENTALIGNS in his plant.

Previously, production difficulties had been posed by bearing design, and the necessity of adherence to very close tolerances. Accordingly, the manufacturer, in selecting his new production equipment, paid special attention to the factors of high production capability, extreme accuracy, and broad versatility.

After exhaustive investigation, Bryant CENTALIGNS were chosen over all competitive grinders. The wisdom of this choice is shown by the results: production increased up to 50% on varied lots of 5000 to 50,000 pieces. Accuracy is held well within specified tolerances.

The unique engineering features of the Bryant CENTALIGN offer *you* top production efficiency, too. Write for detailed literature on Bryant CENTALIGN Internal Grinders.

BRYANT Chucking Grinder Co.

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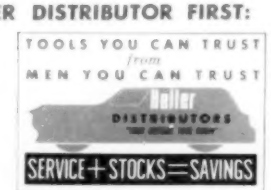
BEST BARGAINS IN THE LONG RUN! You reduce costs three ways when you use Heller High-Speed Steel Rotary Files and Solid Carbide Burrs for smoothing welds and castings or removing burrs. You save filing time because they cut faster. You save money because they last longer. You save extra money because they're resharpenable at a fraction of their original cost.

COMPLETE LINE COVERS MANY USES! Heller Solid Carbide Burrs cut hard, abrasive metals at extremely high speeds. Heller Hand-Cut Rotary Files cut such dense, hard metals as cast iron, die steel, and welds. Heller Ground-From-Solid Rotary files cut softer metals like aluminum, brass and bronze.

CALL YOUR HELLER DISTRIBUTOR FIRST: His knowledge and experience are at your service to recommend new ways to solve problems . . . help you select the best tool for any job . . . get "hard-to-find" special items . . . tailor his inventory to fit your needs. Call him today and see!



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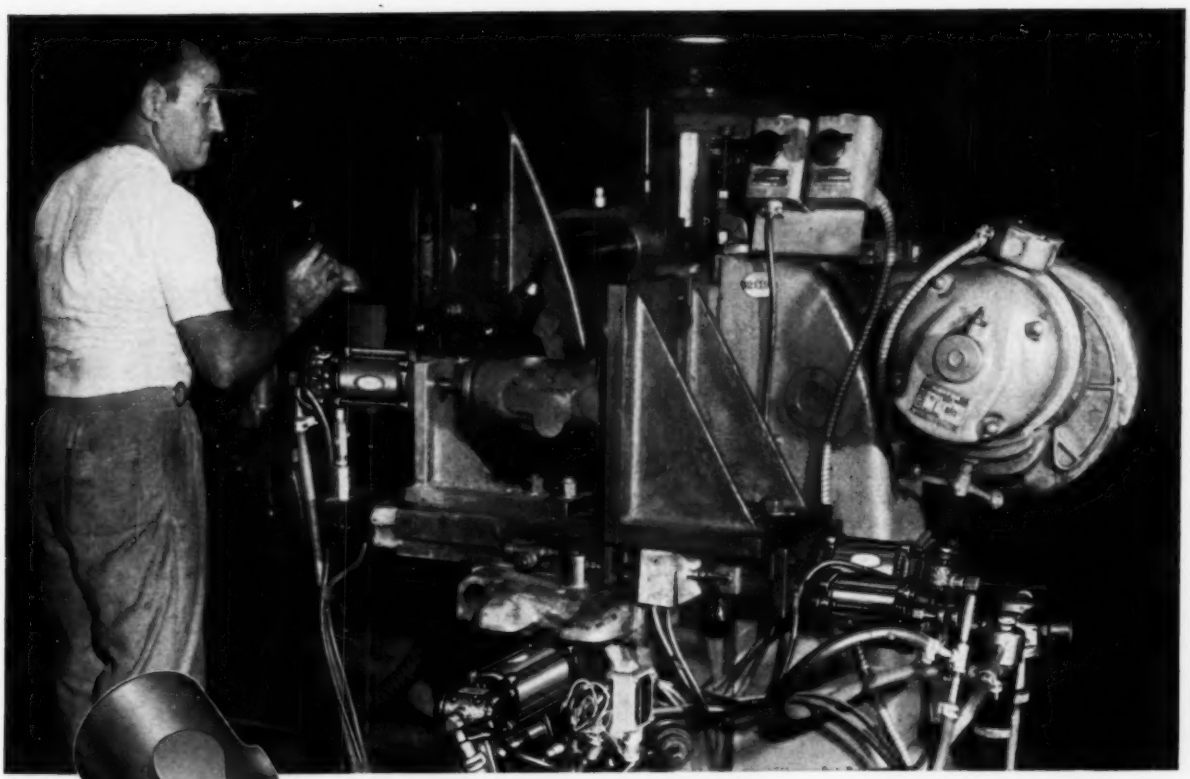

"He took a dim view of the whole idea"

As reported by the foreman of a department at American Bosch, Springfield, Mass.: "We were milling a tapered slot in a 30 lb. housing for a CQ pump. When I told the operator we were going to "automate" the milling operation with Bellows Air Motors, he said "ixnay", he didn't want any part of it.

"You should have seen him at the end of the first day. He went home like he was walking on daisies. 'Baby', he said, 'with this Bellows equipment, milling these 30 lb. housings is a lead pipe cinch.'

"He was happy. We are happy. He gets home in the evening fresh enough to play around the golf course, and we, well, we're getting better tolerances, better finish, at less cost".

** from the case history files of The Bellows Co.*

Wherever Bellows Air Motors and Bellows air-powered production units are used to convert manually operated units to automatic machines, you'll find both operator and management singing their praise. To the operator, Bellows equipment brings less fatigue, greater safety — to management, a better product at lower cost.

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This may be helpful

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The Bellows Co.

DIVISION OF INTERNATIONAL BASIC ECONOMY CORPORATION

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◄ CIRCLE 217 READER SERVICE CARD

CIRCLE 218 READER SERVICE CARD

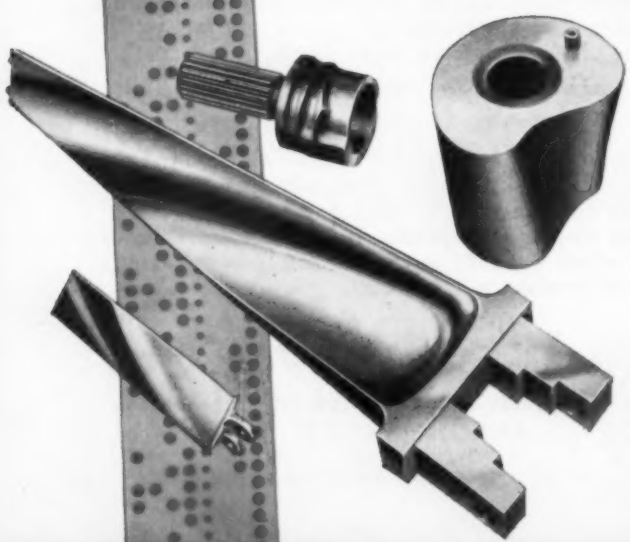
Now—a machine which can realize the full potential of tape control!

FIRST

FIRST to provide 360° work rotation for 3-dimensional machining of complex parts

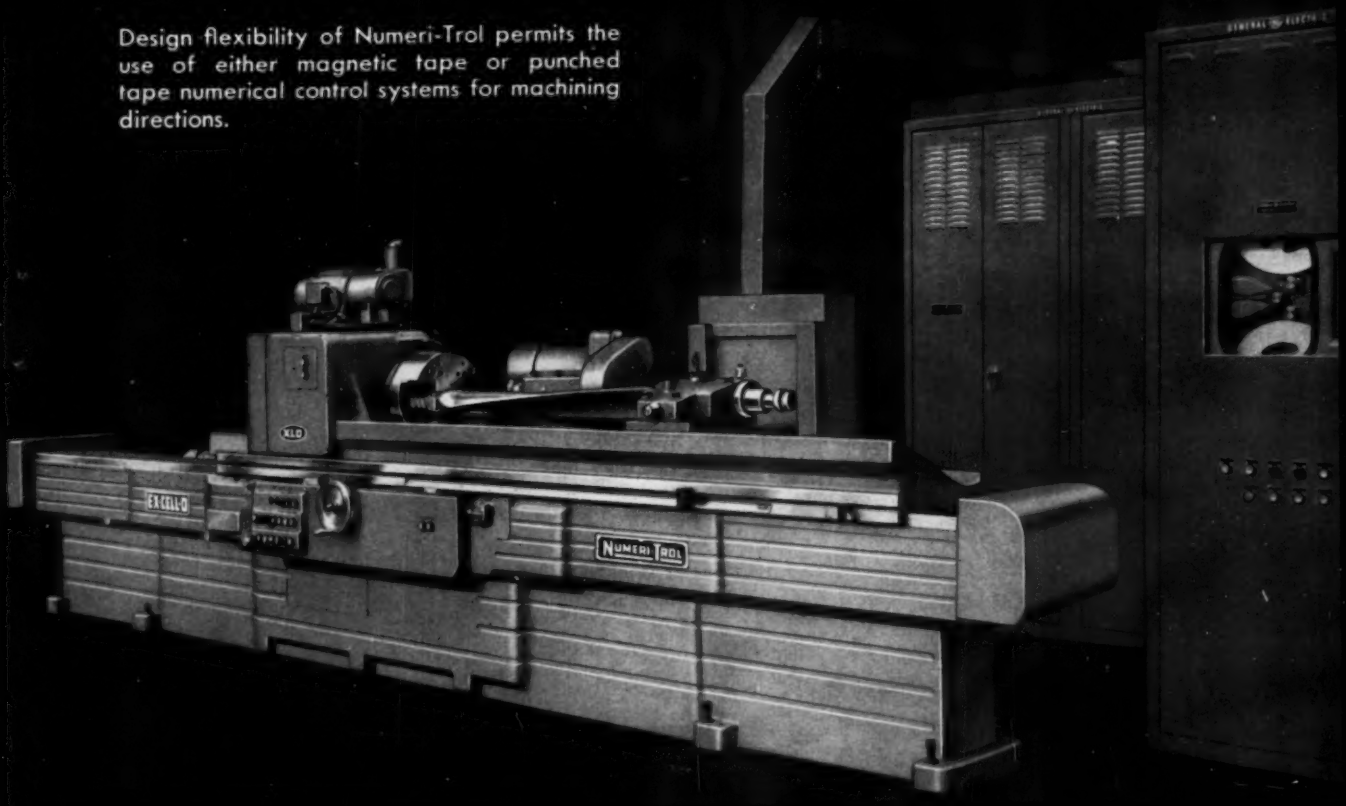
FIRST to combine grinding, dressing, and dressing compensation with milling

NUMERI-TROL



Numeri-Trol slashes lead time, tooling cost and machining time of intricate, three-dimensional prototypes and precision parts. Rotary feed of the work, plus lateral motion of the work head and transverse motion of the cross slide permit milling and finish grinding of parts too complex to be economically produced by conventional methods. Grinding wheel dressing and dressing compensation are fully tape-controlled. In addition to grinding, three-dimensional machining with Numeri-Trol includes conventional rotary milling and longitudinal milling with automatic work feed and 360° indexing.

Design flexibility of Numeri-Trol permits the use of either magnetic tape or punched tape numerical control systems for machining directions.



TAPE CONTROLLED PRECISION PROFILING MACHINES BY EX-CELL-O

Precision-made to heavy-duty production standards, Numeri-Trol sharply reduces machining time and eliminates human error in the production of irregularly-shaped parts. Created especially to take advantage of the accuracy and design possibilities made available by high-performance numerical control systems, Numeri-Trol does away with the need for cams, templates and models; on many once-difficult jobs, it practically eliminates tooling and costly fixtures. Write direct, or ask your Ex-Cell-O Representative how easy it is to "tape" your toughest part and produce it on Numeri-Trol.

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EX-CELL-O CORPORATION
DETROIT 32, MICHIGAN

Machinery Division

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Then why shear 6-inch wide material with a 10-foot shear?

Cutting a small piece of light metal, plastic or rubber on a big shear is even more expensive than it is exasperating. Yet many shops, out of necessity, tie up big shears with small work.

That problem is solved by the New Lodge & Shipley 24" Speed Shear. Specially designed for fast cutting of small pieces, it has a capacity of ⅛" x 24" mild steel. Its unique work table is provided with holes which allow fast set-up of guides, templates and protractors for production of straight-side blanks at speeds up to 120 strokes per minute.

A 24" Speed Shear may easily pay for itself merely in freeing a big shear from wasteful small jobs. Investigate its possibilities in your plant. For detailed Bulletin No. PS-12, write: **The Lodge & Shipley Co., 3056 Colerain Ave., Cincinnati 25, Ohio**

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Boosts production of gas oven thermostats 11½% using Gulfcut

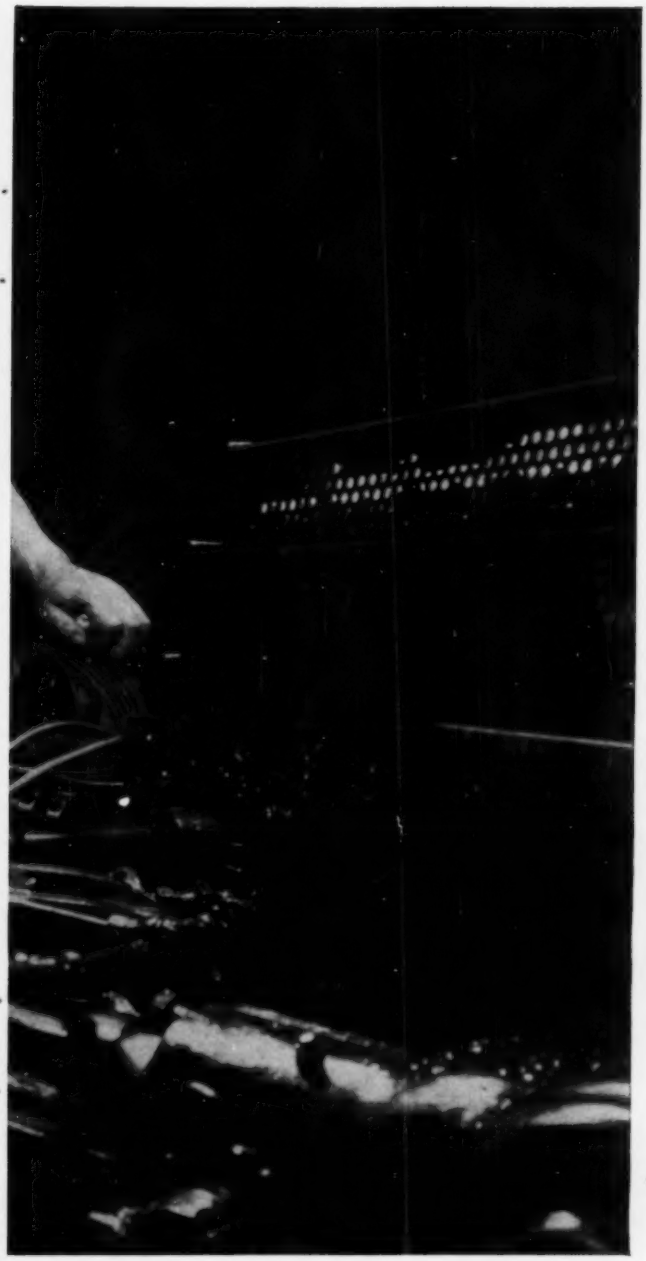
GULF MAKES THINGS

What makes a gas oven thermostat "tick"? The "brain" of the thermostat is a complex valve-control assembly requiring precision machining.

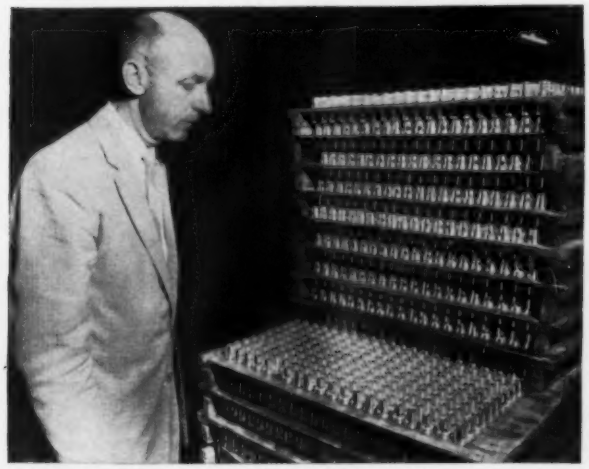
The Wilcolator Company, Elizabeth, New Jersey, turns out thousands of these units a day . . . using Gulfcut 11D Cutting Oil exclusively in the machining of aluminum bodies and plugs for these assemblies.

"We've experimented with a number of different cutting oils on this operation," says Lester C. Stork, Vice President of Manufacturing at Wilcolator. "But only Gulfcut 11D gives us the 20 micro finish we need on certain critical parts. What's more, it helped us increase production by 11½%.

"Better finish and increased production are only part of the story. We like Gulfcut 11D Cutting Oil because it doesn't stain our machines, or contaminate the solvent in our de-greaser. It's safer to work with, too, because of its high flashpoint."



This Heald machine finishes 3 bodies and 3 plugs simultaneously every 19 seconds. Taper cuts are made at 2000 rpm with a feed of .00212. Wilcolator uses Gulfcut 11D cutting oil on this and all other aluminum machining jobs.



Gulf man sees proof that Gulfcut 11D helps Wilcolator get top results in their most critical machining operation. Jacques Schindler, Gulf Sales Representative, notes the perfect finish and the exact fit of the tapered plugs to the bodies.

◀ This 10-spindle Kingsbury automatic drilling and tapping unit machines critical holes in the body of the control valve. Gulfcut 11D was found to be the only cutting oil to give Wilcolator the 20 micro finish required on this surface.

Cutting Oil . . . more proof that

RUN BETTER!

How about your operation? Do you machine nonferrous metals? Non-staining, non-corrosive Gulfcut 11D was developed especially for this use. Try it in your plant. Whatever type of machining you do, there's a shop-tested cutting oil to meet your specific needs in the complete Gulfcut line. See how Gulf makes things run better. Call a Gulf Sales Engineer at your nearest Gulf office, or mail coupon today for illustrated literature on Gulfcut Cutting Oils.

GULF

GULF OIL CORPORATION
Dept. DM., Gulf Bldg., Pittsburgh 30, Pa.
Send me illustrated bulletin on
☐ Gulfcut "Regular" Cutting Oils
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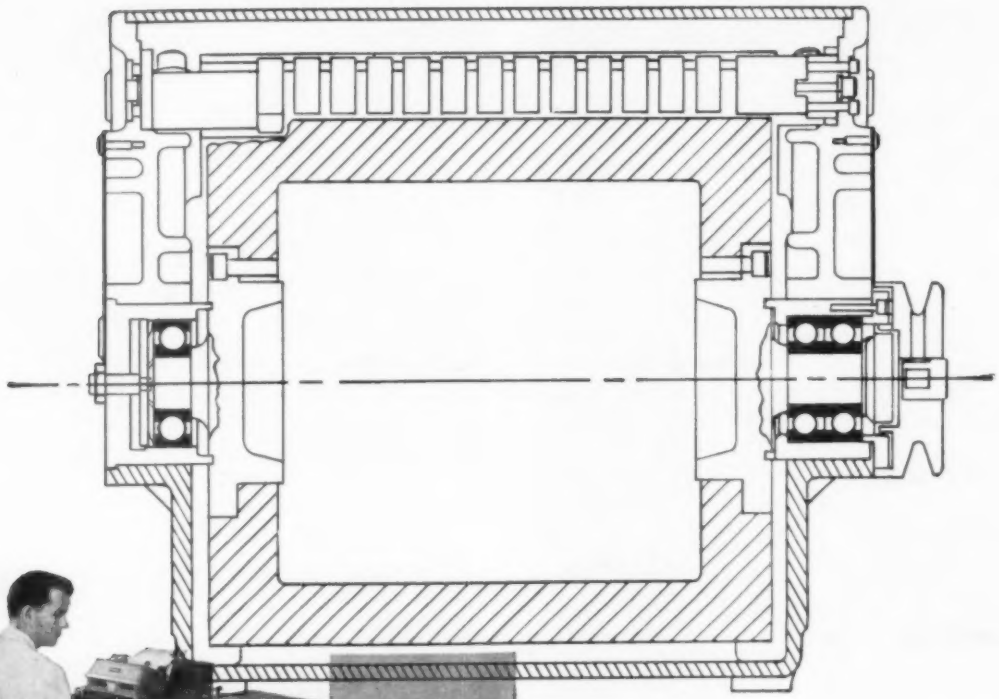
AM-5234



"NO ROOM FOR ERROR"

in design of desk-size LGP-30 digital computer!

Precise performance assured in Librascope's Fafnir-equipped LGP-30

Small as a desk, but it "thinks big"! No less than 4096 words can be recorded on the magnetic memory drum of the new Royal Precision Electronic Computer LGP-30. Moreover, this compact unit, made by Librascope, Inc., a subsidiary of General Precision Equipment Corporation, can be rolled where it's needed and plugged into any conventional wall outlet.

At the heart of this versatile computer, Fafnir super-precision type ball bearings maintain the precise alignment and high sensitivity required of the drum component. Counterbored to take a wide range of thrust, and radial loadings, these bearings provide the rigidity, extremely close-running accuracy, and low torque essential in this exacting application.

Fafnir's contribution to the development of the LGP-30 is another case history example of the high caliber and comprehensive scope of Fafnir design engineering services available to *you*. Take advantage of it when you have a bearing problem. The Fafnir Bearing Company, New Britain, Conn.

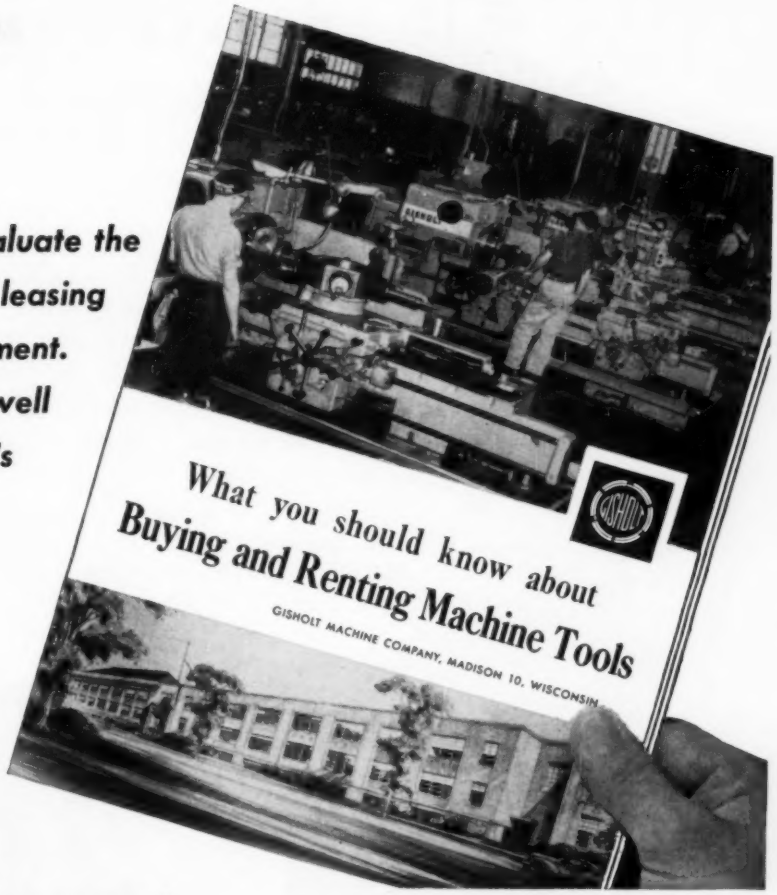
The new Royal Precision LGP-30 is a serial, single address, fixed point binary, stored program digital computer featuring simplified design and ease of operation. The unit is designed to make computer use economical and simple enough for more widespread application.

Fafnir Super-Precision Type Ball Bearings are used in duplex pairs, mounted back-to-back, at the pulley end of the LGP-30 memory drum, and singly at the opposite end. These preloaded, angular-contact bearings, equipped with composition or bronze retainers, are widely used in precision-built mechanisms.

FAFNIR
BALL BEARINGS
MOST COMPLETE LINE IN AMERICA

Can your competitors turn metal at lower costs?

***Now** is the time to re-evaluate the possibilities offered by leasing of new production equipment. Your decision today can well determine your company's position in tomorrow's competitive market.*



This free booklet tells how you can get new machines with minimum capital outlay

If you have delayed replacing old machines because of the relatively large capital investment, acquisition by methods other than outright purchase may solve your problems. Only a minimum initial investment provides you with the many competitive advantages that new machines offer, including greater accuracy, higher production rates and faster setup. New features and accessories simplify even the toughest jobs. Secondary operations are minimized and spoiled work becomes a thing of the past. All this means lower unit cost—more profit for you.

If you want the benefits that new machine tools can provide, and if you like the idea of letting them "pay their way" while they "turn" a profit for you, you'll want to write for Gisholt Bulletin 1173 on buying and renting machine tools. It fully explains one of the most liberal and comprehensive policies in the industry, and covers several types of leasing and time payment plans with vital information on depreciation, tax angles, the MAPI formula and other timely questions. The coupon will bring your free copy. Send it along today.

GISHOLT MACHINE COMPANY
Madison 10, Wisconsin

ASK YOUR GISHOLT REPRESENTATIVE ABOUT FACTORY-REBUILT MACHINES WITH NEW-MACHINE GUARANTEE

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Madison 10, Wisconsin

Without obligation, please send your Bulletin 1173.

Name.....*Title*.....

Company.....

Street address.....

City.....*Zone*.....*State*.....

"Buffalo"

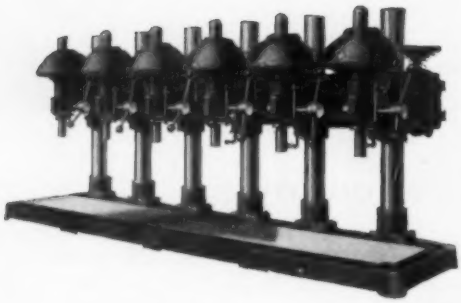
DRILLS "TEAM-UP" WITH TO INCREASE QUANTITY AND

"Buffalo" offers a wide range of complete drilling machine lines in sizes, models and capacities to custom-fit all your jobs — from production and maintenance to tool room and other precision work. Choose from bench or floor types, single or multispindle, sensitive or power feed.

"Buffalo" Drilling Machines are designed for the utmost ease and simplicity of operation. They literally "team-up" with the operator as an incentive to higher quality production and faster runs. Sturdy, accurate, dependable, they are engineered with conveniently-located controls and are quickly adjustable for setup changeovers.

Whatever your drilling needs, contact your nearest "Buffalo" machine tool dealer. He will be glad to analyze your operations and recommend the drilling machine that's designed to fit your exact requirements. Or write us direct.

Engineered into every "Buffalo" product is the famous "Q" Factor — the built-in QUALITY which provides trouble-free satisfaction and long life.



Heavy-Duty Drill for Multiple Operations

The "Buffalo" No. 18 Drill Line includes 19 models, enabling you to choose the drill that's best-suited to your needs. Models range from single spindle bench and floor drills to 6-spindle units. Powerful, rugged, easy to adjust and operate, the "Buffalo" No. 18 Drill is a flexible tool for general shop work up to 1 inch cast iron. Write for Bulletin 3123-E.

New! Packed with Advanced-Design features

The "Buffalo" No. 15 line of Drilling Machines is all new, from head to base. Retained are all the sturdy, speedy, easy-operating, trouble-free features of earlier models. Added are a host of design improvements which facilitate operation, flexibility and maintenance. Extremely sensitive, the No. 15 is also sufficiently rigid to operate at full capacity without wear or strain. Full information in Bulletin 4024 — write for it today.

More for Your Drill Dollars

The "Buffalo" No. 16 Drill is a "best buy" in its range. Check these features — then check the price: 5-speed V-belt drive — 4 rates of power feed — hardened tool steel clutch members — hand-scraped table ways. These assure you easier, faster drilling, more accurate work, longer useful tool life, lower overall production costs. For complete details on the "Buffalo" No. 16 Drill, write for Bulletin 3720-G.

YOUR OPERATORS QUALITY OF OUTPUT!

POWER—
To Drill up to 1-¼" Holes in Mild Steel

"Buffalo" No. 22 Drills are ideally suited for high production drilling and tapping operations of a complex nature. With the No. 22, one man can operate up to four setups with no time out for adjustments. These sturdy, powerful machines handle as easily as smaller, sensitive drills — each spindle has both power and sensitive feed. See how you can cut costs and speed production with "Buffalo" No. 22 Drilling machines. Write for Bulletin 2989-G today.

Speeds Instantly Changed with No Lost Time

The "Buffalo" "RPMster" features "line-of-sight" controls that enable the operator to change spindle speeds instantly in the range between 100 and 3000 RPM. The gearless drive and precision construction assure a minimum of vibration at all speeds. Hand scraped ways on head and table. The versatile "RPMster" will improve production in all your drilling, reaming and tapping operations. For full information, write for Bulletin 3967-A.

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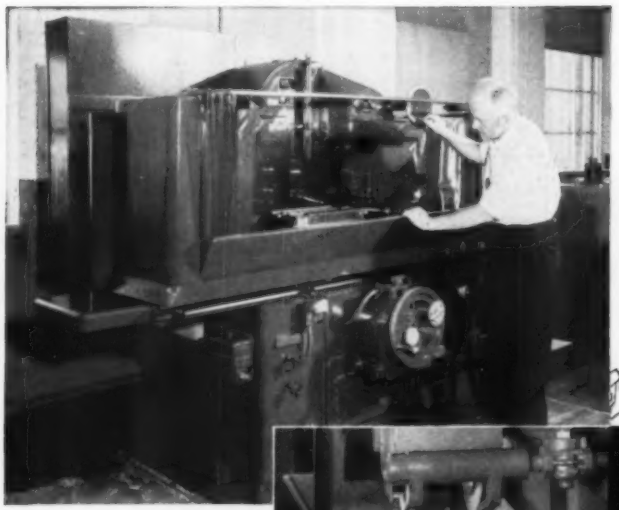
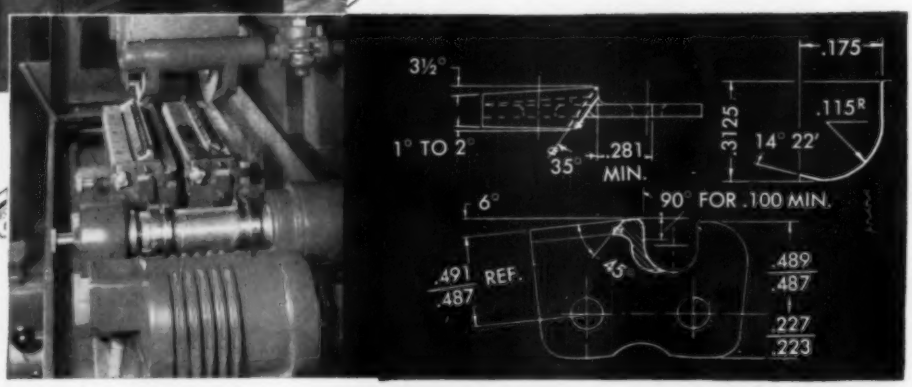
DRILLING PUNCHING SHEARING BENDING

ESTABLISHED 1877 "Buffalo" MEMBER N.M.T.B.A.

Thompson — TRUFORMING CUTS COSTS 60%





For 140 years, the policy of The Draper Corporation of Hopedale, Mass., has been to offer the highest quality product at the least possible cost.

Following this policy, its subsidiary, BlueJet Corporation, manufacturers of the famous BlueJet saw chain, installed a Thompson Truforming grinder to grind the cutting edges on their chain saw routers. These routers were formerly ground, piece by piece, by a force of 8 employees.

The Thompson Truforming operation is now cutting former grinding costs by 60%. 3 men only are now required for the operation. 40 L.H. and 40 R.H. routers are now ground simultaneously with one pass of the crush formed wheel, resulting in a day's production of over 12,000 pieces—many times that produced by the former method. Both the uniformity and sharpness of the routers have been greatly improved.

For 25 years, Thompson has pioneered and developed the modern advances in crush form grinding. If you have a time-saving, product-improving or cost-cutting problem in your operations, it will pay you to investigate the work Thompson Truforming grinders are now doing in plants all over the country. Our engineering experience is available to you without obligation. Write for Catalog T558.

"Keep Thompson in mind for the daily grind"

THE THOMPSON GRINDER COMPANY

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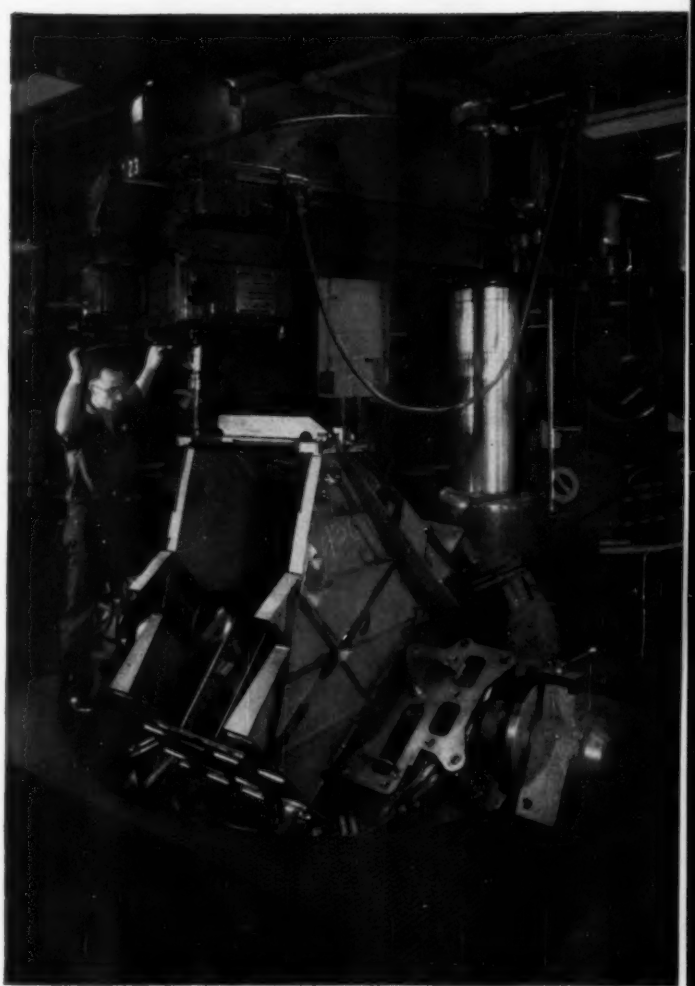
SURFACE GRINDERS

A Winning Combination...

"American" HOLE WIZARD RADIAL } + { INGENIOUSLY DESIGNED FIXTURES



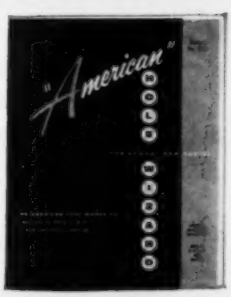
The time on this job was cut to the bone by the combination shown by the illustration. All boring, facing, drilling, tapping and counterboring on the entire job was done in one work setting by means of an ingenious swiveling fixture.

The essential contributor to satisfactorily performing this variety of work is unquestionably the "AMERICAN" Double Lo-Hung Spindle Drive. This is an exclusive "AMERICAN" Hole Wizard feature. It divides the speed range into two separate ranges; the high speeds through a comparatively small gear to minimize gear velocities; the low speeds through a large diameter, wide faced gear to reduce gear tooth pressures to insure minimized wear under severe service.

To further reduce wear and to insure maintenance of original accuracy the spindle and sleeve are made of nitralloy steel nitrided for extreme surface hardness and are mounted on large precision Timken Bearings with convenient outside adjustment which guarantees maximum life, dependable operation and unequalled spindle stability for the life of the machine.

These exclusive "American" features permit your putting your radial drills to work at a profit

There are other advantages too — write for bulletin No. 328.



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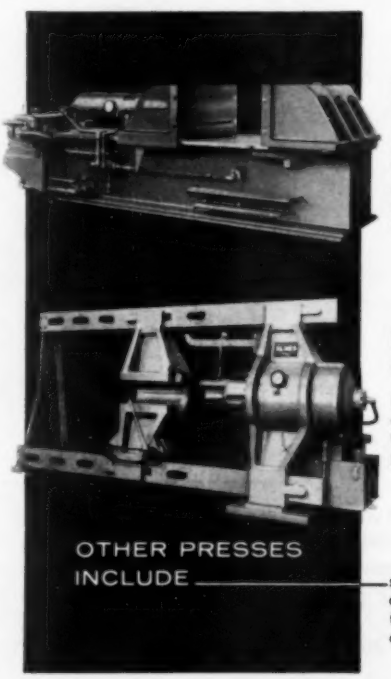
"Job-Fitted" HYDRAULIC PRESS

Hundreds of manufacturers have called on Elmes to help solve production problems involving pressure application. It's no secret that Elmes engineering is pre-eminently qualified to provide this profit-making service—to recommend *the right press for the job.*

It will pay *you*, too, to call in Elmes on your pressing problems. Maybe your answer is in one of the many standard Elmes® designs, either "as is" or with simple modification. Or, if your requirements are special, Elmes will develop a "custom-built" press to fit your needs *exactly*. This special-design function has long been an important part of Elmes' service to industry.

In any case, you'll be wise to take advantage of engineering knowledge, skill, and foresight backed by more than 60 years of leadership in specialized hydraulic service. Recommendations and cost estimates promptly supplied. See your Elmes Distributor, or write us direct.



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LIFT THIS PAGE TO SEE WHY

A. O. SMITH WELDING MACHINES STAND "HEAD AND SHOULDERS" ABOVE ANY OTHER MACHINES...

The following pages provide proof that "Through research, there is a better way"

Through research ... a better way

A.O.Smith

CORPORATION

WELDING PRODUCTS DIVISION

Milwaukee 1, Wisconsin

A. O. Smith INTERNATIONAL S. A., Milwaukee 1, Wisconsin, U.S.A.

These are some of the "tangible" reasons why

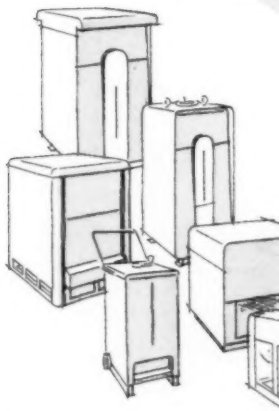
A. O. SMITH WELDERS OUT-PRODUCE, OUT-LAST THEM ALL

No other line of welders can offer all these stand-out advantages...

While other welding machine manufacturers have been cutting corners on materials, on fabricating care, on special features — A. O. Smith has been operating in the opposite direction. New and better (though more expensive) materials have been used. And instead of short-cutting precision manufacture — A. O. Smith has improved their own manufacturing techniques to the point where you get premium quality at mass-production costs.

Further, each A. O. Smith machine has been fully "floor tested" in actual production. A. O. Smith is one of the world's largest users of welding in its own production!

Check over just a few of the reasons why A. O. Smith welders give you bonus hours of un-interrupted production at lower cost —with improved welding characteristics.



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dc rectifier
gasoline dri
Also, the
con

Totally enclosed, pre-l
ball bearing, ⅙-hp fa
big fan — Only A. O.
machines are built wi
forget-about-it motor t
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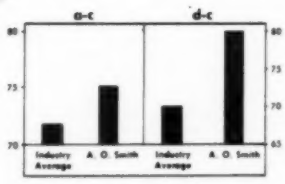
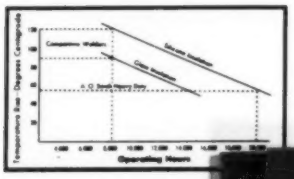
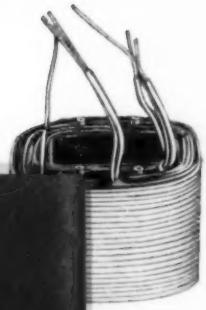


Generally speaking, A. O. Smith machines offer more open circuit volts than any other lin
And more open circuit volts mean more arc stability, faster arc action, smoother operation at any setting. You get better welds, fewer rejects.





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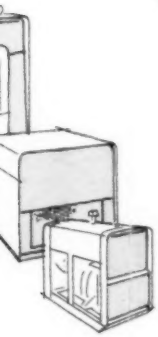

A. O. Smith offers 39 basic machines —
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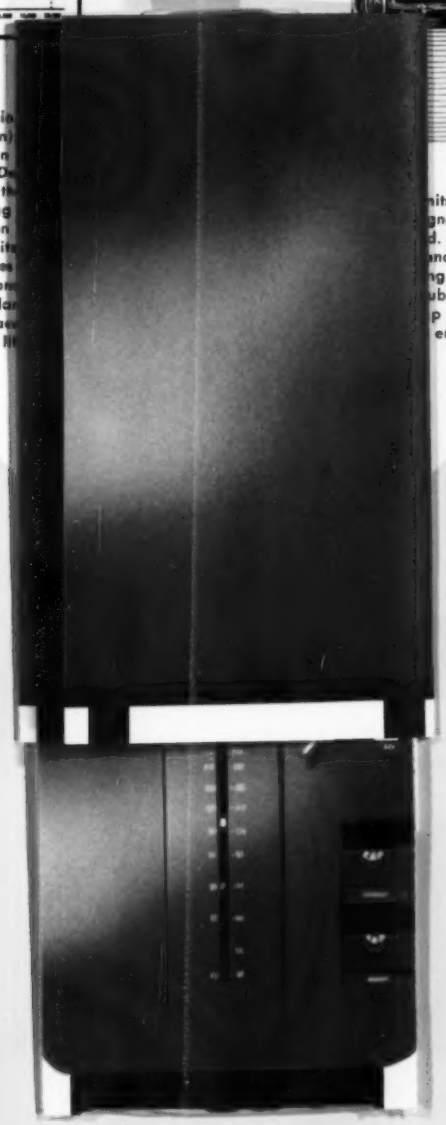
asoline driven models, constant potentials.
Also, there are plug-in "shoe-box size"
convertors that convert ac machines
to dc in seconds.



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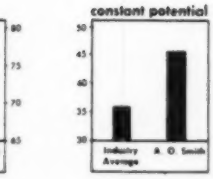

machines
y other line.
mean
, smoother
better

See the model ratings on the back page and check with your "man from A. O. Smith" for comprehensive details . . .

Through research . . . a better way

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Milwaukee 1, Wisconsin

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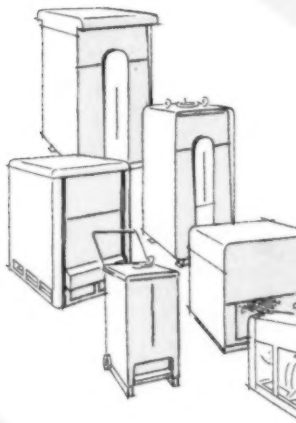

A. O. Smit
limited input,
dc rectifiers,
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Totally enclosed, pre-lub
ball bearing, ⅓-hp fan
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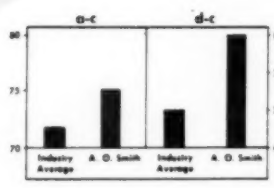

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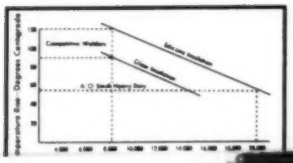

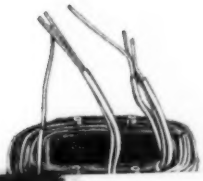

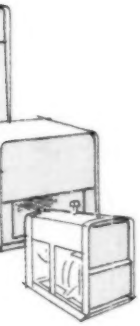

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convertors that convert a
to dc in secon

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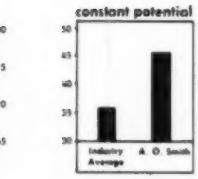
MORE MOTOR —MORE FAN

OPERATIONAL FLEXIBILITY



achines
other line.
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See the model ratings on the back page and check with your "man from A. O. Smith" for comprehensive details . . .

Through research . . . a better way

A.O.Smith
CORPORATION
WELDING PRODUCTS DIVISION
Milwaukee 1, Wisconsin
A. O. Smith INTERNATIONAL S. A., Milwaukee 1, Wisconsin, U.S.A.

These are some of the "tangible" reasons why

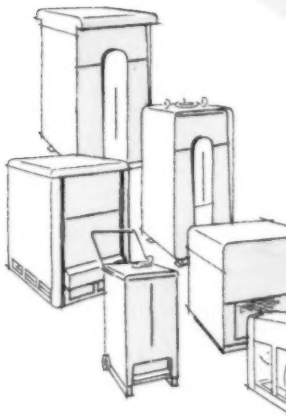
A. O. SMITH WELDERS OUT-PRODUCE, OUT-LAST THEM ALL

No other line of welders can offer all these stand-out advantages...

While other welding machine manufacturers have been cutting corners on materials, on fabricating care, on special features — A. O. Smith has been operating in the opposite direction. New and better (though more expensive) materials have been used. And instead of short-cutting precision manufacture — A. O. Smith has improved their own manufacturing techniques to the point where you get premium quality at mass-production costs.

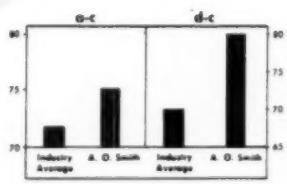
Further, each A. O. Smith machine has been fully "floor tested" in actual production. A. O. Smith is one of the world's largest users of welding in its own production!

Check over just a few of the reasons why A. O. Smith welders give you bonus hours of un-interrupted production at lower cost —with improved welding characteristics.

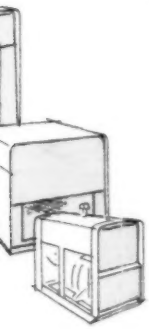


A. O. Sm
limited input,
dc rectifiers
gasoline driv
Also, ther
conv

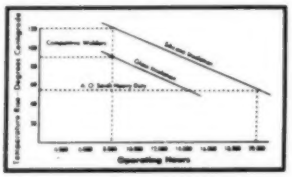
Totally enclosed, pre-lu
ball bearing, ¼-hp fa
big fan — Only A. O.
machines are built wit
forget-about-it motor th
reservoir filling or othe
stopping maintenance.
the industry, sustains tr
of high-velocity air to
running cool.



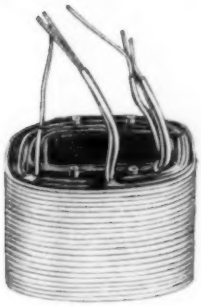
Generally speaking, A. O. Smith machines offer more open circuit volts than any other line
And more open circuit volts mean more arc stability, faster arc action, smoother operation at any setting. You get better welds, fewer rejects.



A. O. Smith offers 39 basic machines — ted input, general-duty ac, heavy-duty ac, rectifiers, air and liquid cooled oline driven models, constant potentials. Also, there are plug-in "shoe-box size" convertors that convert ac machines to dc in seconds.



All A. O. Smith machines have it! Silicone (Class H insulation) is the newest, most expensive insulation known to the electrical industry. Despite higher costs, A. O. Smith is the *only* machine manufacturer using silicone "right-across-the-board" on *all* models. Silicone permits higher operating temperatures under peak load conditions and absolutely prevents coil damage due to moisture accumulation. Longer life is assured.



On A. O. Smith units, coils are not only vacuum-impregnated, they're also precision wound. Result: They're resistant to moisture and there's no possibility of chafing each time an arc is struck. This double protection results in stepped-up efficiency — for years on end.

SILICONE INSULATION

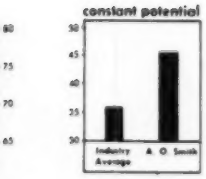
DOUBLY PROTECTED COILS

TAILORED TO YOUR NEEDS

MORE MOTOR —MORE FAN

OPERATIONAL FLEXIBILITY

ed, pre-lubricated, ½-hp fan motor and nly A. O. Smith welding built with a big husky, t motor that needs no g or other costly production-ntenance. Biggest fan in sustains tremendous volume ty air to keep machine



achines other line. mean smoother better

See the model ratings on the back page and check with your "man from A. O. Smith" for comprehensive details . . .

Through research . . . a better way

A.O.Smith

WELDING PRODUCTS DIVISION

Milwaukee 1, Wisconsin

A. O. Smith INTERNATIONAL S. A., Milwaukee 1, Wisconsin, U.S.A.

Quick guide to **A.O.Smith** welding machines

a-c welding machines

	Series No.	Rated Output Amps.	Volts	KW	KW Input	Open Ckt. Volts	Efficiency %	Power Factor %	Line Amps. @ 230V	Line Amps. @ 460V	Welding Range Min.	Max.	Duty Cycle %
A-C LIMITED INPUT TYPE	A18U	180	25	4.5	6.35	53/80	71	No Cap.	45		25	180	20
	A180U	180	25	4.5	6.0	53/80	70	70	37		25	180	20
	A20S	200	30	6.0	8.35	80	72	No Cap.	88.5		30	310	50
		295	25	7.4	8.35	80	72	No Cap.	88.5		30	310	20
HEAVY-DUTY A-C PRODUCTION WELDERS	A200E	200	40	8	10.6	75	75.6	70	66	33	30	350	60
	A300E	300	40	12	14.2	75	84.5	72	85.2	42.6	60	430	60
	A400E	400	40	16	18.6	75	84	72	108	54	75	585	60
	A500E	500	40	20	25.3	75	79	70	144	72	90	670	60
	A650E	650	40	26	30	80	86	72	176	88	200	750	60
EXTRA HEAVY-DUTY PRODUCTION WELDERS	A300	300	40	12	14	75	85.5	88.5	72	36	60	375	60
	A400	400	40	16	18.6	75	86	86	98	49	80	500	60
	A500	500	40	20	23.6	75	85	83.7	128	64	100	625	60
AUTOMATIC A-C PRODUCTION WELDERS	A1000	1000	40	40	44.4	85/100	90	80	244	122	250	1250	1 hr. 100% 3 hr. 75%
	A1500	1500	40	60	66.7	85/100	90	80	366	183	400	1800	1 hr. 100% 3 hr. 75%

d-c welding machines

	Series No.	Rated Output Amps.	Volts	KW	KW Input	Open Ckt. Volts	Efficiency %	Power Factor %	Line Amps. @ 230V	Line Amps. @ 460V	Welding Range Min.	Max.	Duty Cycle %
D-C RECTIFIERS	A2000	200	40	8	12.4	80	64	77.5	40	20	25	345	60
	A3000	300	40	12	19.5	80	64	77	64	32	45	500	60
	A4000	400	40	16	25.0	80	64	75	84	42	55	650	60
	A6000	600	40	24	34.5	80	69.5	70	124	62	120	730	60
AUTOMATIC D-C RECTIFIERS	A8000	800	40	32	45	80	71	76	164	82	200	1050	100
	A10000	1000	40	40	57.2	80	70	72	200	100	200	1240	100
	A12500	1250	40	50	69.4	80	72	70.6	247	123	265	1500	100
	A25000	2500	Information available on request.										
CONSTANT POTENTIAL	A6000 CP	600	40	24	32	0/50	75	99	82	41	0 Amps @ 0 Volts	600 Amps @ 45 Volts	100
MULTIPLE OPERATOR POWER SOURCES	A5000 MO	500	74.5	37.25	40.4	80	92.5	93		55	0	500	100
	A7500 MO	750	75	56.2	59.2	80	95	96		73.5	0	750	100
	A15000 MO	1500	73.5	110	117.2	80	95	97		152	0	1500	100
AC/DC INERT ARC WELDERS	A2000 AD	AC 200	40	8	10.1	AC 75	AC 79	AC 76	58	29	AC 7	AC 300	60
		DC 200	25	5	10.4	DC 68	DC 48	DC 76	58	29	DC 5	DC 200	60
	A3000 AD	AC 300	40	12	15.4	AC 75	AC 78	AC 76	90	45	AC 10	AC 440	60
		DC 300	25	7.5	15.0	DC 68	DC 50	DC 76	90	45	DC 7	DC 300	60
	A5000 AD	AC 500	40	20	25.3	AC 75	AC 79	AC 75	148	74	AC 12	AC 670	60
		DC 500	25	12.5	25.5	DC 68	DC 49	DC 75	148	74	DC 10	DC 500	60
D-C CONVERTORS	A2500 C	Model A2500 C is DUAL RATED						250 Amps @ 40 Volts, 60% Duty Cycle 300 Amps @ 40 Volts, 40% Duty Cycle					
	A4500 C	Model A4500 C is DUAL RATED						450 Amps @ 40 Volts, 60% Duty Cycle 500 Amps @ 40 Volts, 45% Duty Cycle					
D-C GAS DRIVES (Air and Liquid Cooled)	A2000 A	200	30	6		67					45 Amps. @ 30 Volts	200 Amps. @ 30 Volts	50
	A2000 WG	200	40	8		80					40 Amps. @ 20 Volts	250 Amps. @ 40 Volts	60
	A3000 WG-S	300	40	12		80					60 Amps. @ 20 Volts	375 Amps. @ 40 Volts	60
	A4000 WG-S	400	40	16		80					80 Amps. @ 20 Volts	500 Amps. @ 40 Volts	60

GUARANTEE — All A. O. Smith Welding Machines are guaranteed to provide for free replacement of any part that fails, due to defective workmanship or material, within one year from date of purchase.

BEFORE YOU BUY ANY WELDING MACHINE, investigate this line in detail. You'll see why you buy better when you buy A. O. Smith job-matched power.

PRODUCED BY WELDERS — FOR WELDERS: Because welding is our full-time business, we can offer you America's finest welder-proved electrodes, machines and accessories.

Through research ... a better way

A.O.Smith
CORPORATION

WELDING PRODUCTS DIVISION
Milwaukee 1, Wisconsin

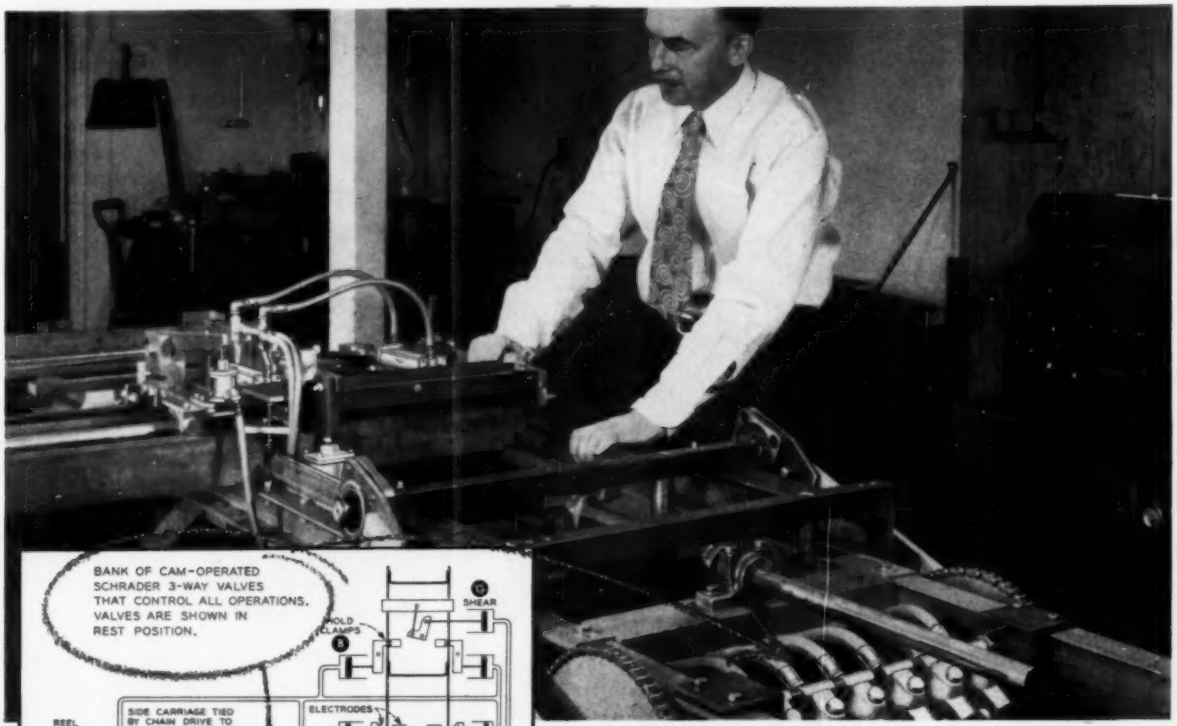
A. O. Smith INTERNATIONAL S. A., Milwaukee 1, Wisconsin, U.S.A.

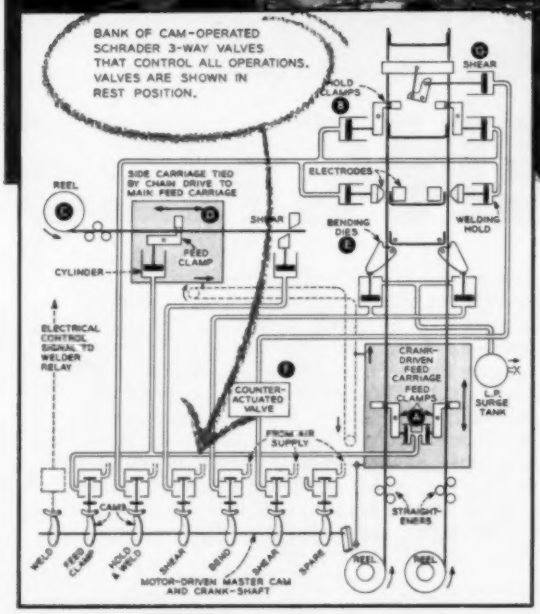
MW-231 9-58 LITHO U. S. A.

YOU, TOO, CAN AUTOMATE IT YOURSELF ...WITH SCHRADER AIR PRODUCTS

Very often you can automate manufacturing operations simply by applying Schrader air controls to existing plant facilities.

Here's a man with ideas who automated a complex job—increased production, reduced unit costs, safely and easily—without making a large capital investment. He did it with a planned Schrader air control system. Chances are excellent that you can do the same thing—with Schrader air products. Air can do an almost limitless range of work: automatic drilling, reaming, clamping and holding, shearing, forming, staking, grouping and interlocking assembly operations for quicker parts handling and assembly.





PROBLEM: Feed heavy wires into machine, shear off pieces, shape them, weld pieces together and eject as finished wire webbing. Fast. Economically. Automatically.

SOLUTION: Air Controls selected from Schrader's complete line. Neat bank of valves—actuated by cams on master cam shaft—operate synchronized system. Clamps A feed wires to holding Clamps B as carriage moves back and forth. Counter-actuated valve F operates cut-off shear G after desired number of cycles. Wire C, fed from carriage D, is sheared, formed by dies E, welded to the other two wires.

RESULT: One man performs *double* the output of three men at a fraction of the cost of a new machine.

Design it yourself! Schrader Air Control components—the most reliable self-contained power units—can help you adapt quickly to your manufacturing needs.

Schrader®
a division of SCOVILL

QUALITY AIR CONTROL PRODUCTS

A. SCHRADER'S SON • *Division of Scovill Mfg. Co., Inc.*
460 Vanderbilt Ave., Brooklyn 38, N. Y.

How do I start? How did others get started? Send me informative literature and information about Schrader's Automate-It-Yourself Air Products.

Name_____ Title_____

Company_____

Address_____

◄ CIRCLE 235 READER SERVICE CARD

CIRCLE 236 READER SERVICE CARD

Fine tools that encourage Good Work

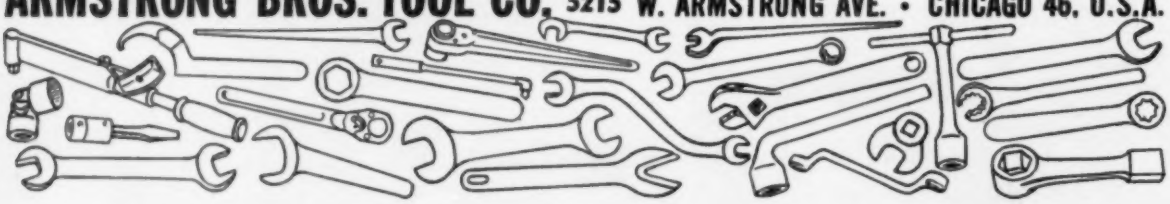
ARMSTRONG WRENCHES

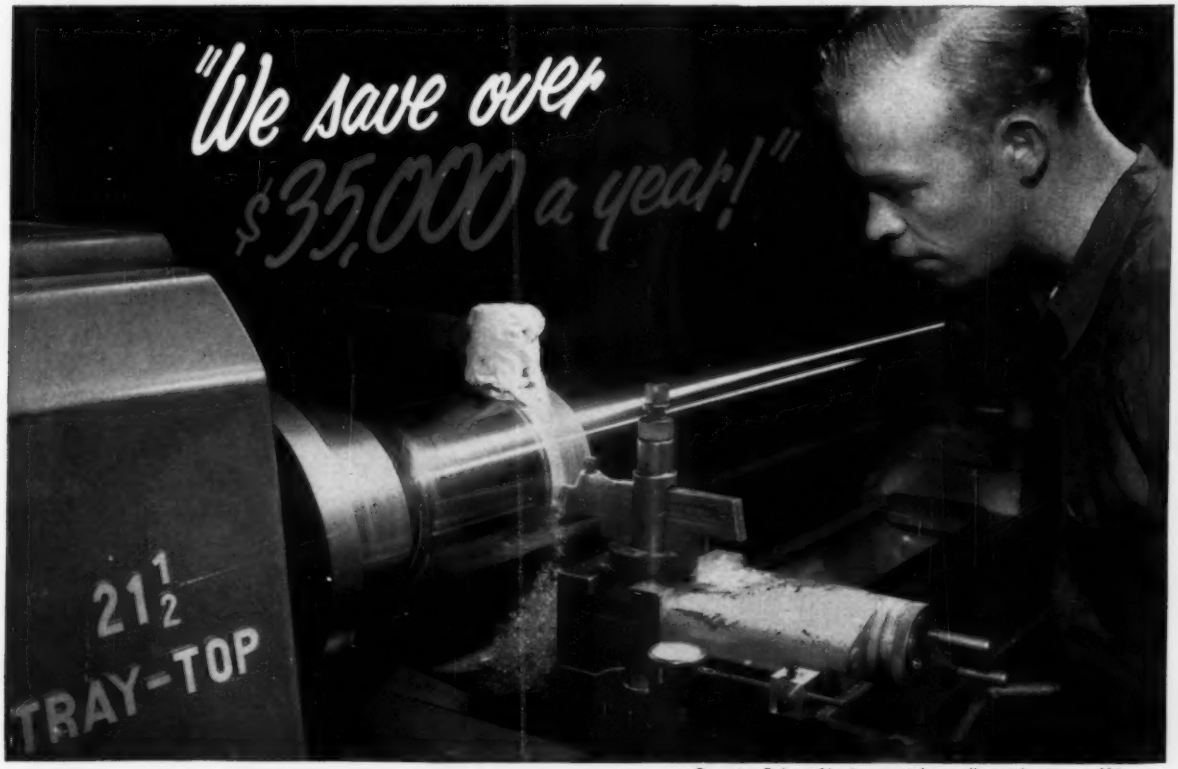
An ARMSTRONG Wrench feels right—is balanced. It goes over nuts or screw heads easily, grips firmly without sloppiness, won't round corners—because openings are carefully machined to correct sizes. It's safe, strong beyond need without clumsy bulk—because of superior design and selected steels, heat treated to proper degree of hardness and tensile strength. It's quality finished, ARMALOY (alloy steel) Wrenches in chrome plate with heads buffed; HI-TEN (carbon steel) Wrenches in baked-on gray enamel with heads ground bright . . . all plainly marked for size. All are uniformly excellent tools manufactured under strict quality control, by modern methods, with modern equipment in a modern tool plant . . . 1537 different industrial sizes and types—single wrenches, or sets in metal cases, boxes or rolls . . . each a quality tool. Armstrong Wrenches are "Fine tools that encourage good work."

INDUSTRIAL DISTRIBUTORS · SERVING INDUSTRY ECONOMICALLY · THE RIGHT HAND OF PRODUCTION

If you don't know your local ARMSTRONG Distributor, we will send you the names of those in your area.

ARMSTRONG BROS. TOOL CO. 5215 W. ARMSTRONG AVE. • CHICAGO 46, U.S.A.





Operator Robert Oberhausen takes a diamond cut on a 48" long gravure printing cylinder at Southern Gravure Service.

OLD METHOD

Semifinish turn in multiple passes on a lathe.

•

Four separate polishing stages on a converted grinder.

NEW METHOD

First turn on Tray-Top with carbide cutter—second with diamond tool (each pass held within 0.0002" tolerance).

•

One final polishing operation to produce the required 2 microinch finish.

CINCINNATI "Tray-Top" Precision Eliminates 3 Polishing Stages on Printing Rolls

Southern Gravure Service, Inc., Louisville, wanted to hold 0.0005" tolerance in 60" of turning on printing cylinders. Both the 21½" and the 18" Tray-Top which they tried on the job consistently are holding 0.0002" on cylinders ranging from 4" to 14" in diameter, up to 75" long, and weighing from 250 to 500 lbs.

"Ability of these standard CINCINNATI lathes to hold such close tolerance *without modification* has eliminated need for three grinding operations," states John Schaefer, Southern Gravure's mechanical engineer. He estimates total savings at better than $35,000 per year.

The "extra-sturdiness" of lathe bed, carriage and tailstock that is so vital to precision performance like this is only one of the many *features built into every CINCINNATI Lathe.* Why not talk it over with your CL&T Dealer and get economy-priced Tray-Tops into your profit picture!

Improved Machining Through Research

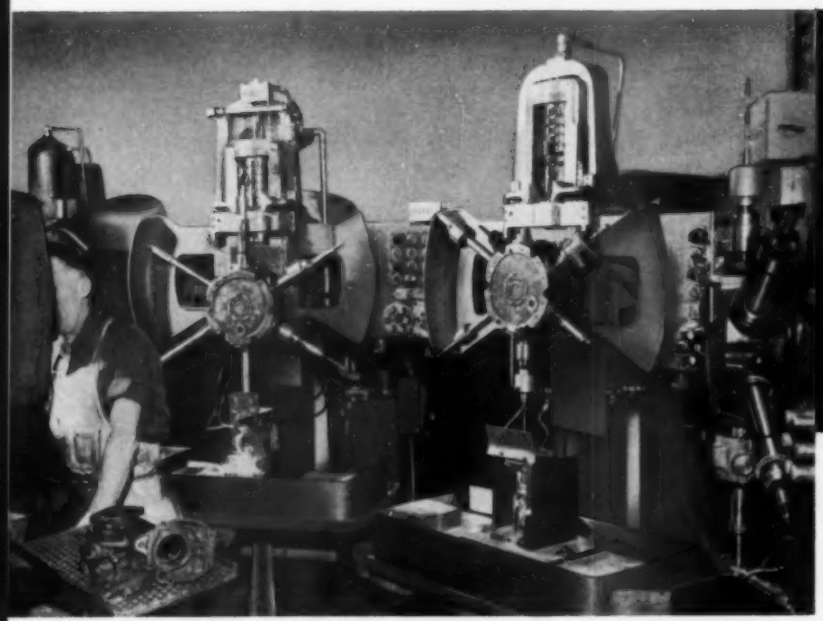
CINCINNATI LATHE AND TOOL CO.

3207 Disney Street • Cincinnati 9, Ohio

"TRAY-TOP" Lathes / "CINCINNATI" Drilling Machines / "SPIROPOINT" Drill Sharpeners

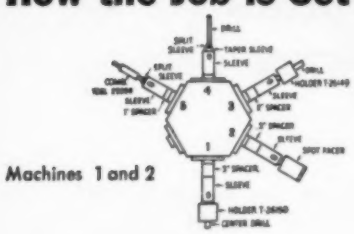
Machining costs of Carburetor Bowls with *Burgmaster* 2BH

(¾" DRILL CAPACITY IN STEEL)

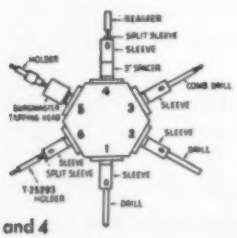


One man conveniently runs a bank of 4 Burgmasters which require only loading, unloading, and starting. The line now includes 12 machines arranged in 3 banks of 4. Note the easy stock handling system.

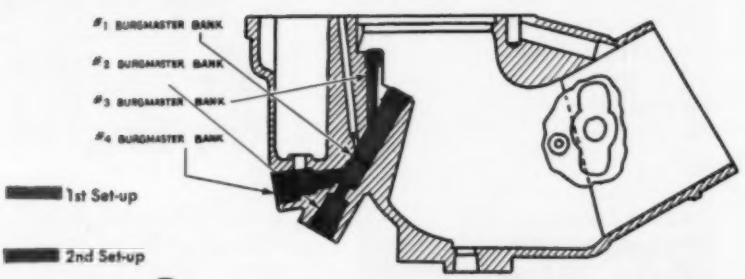
How the Job is Set Up

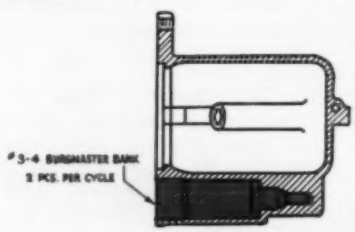


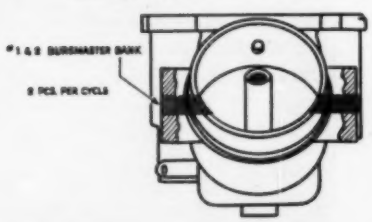
Machines 1 and 2



Machines 3 and 4



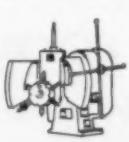




Specialists in High Production Turret Drilling

1C Manual Power Index ⅜" Capacity

2B Manual Power Index ¾" Capacity



2BF Flange Mounted Power Index ¾" Capacity

2BH Automatic Hydraulic ¾" Capacity

3BH Automatic Hydraulic 1½" Capacity

2BR Ram Type Radial Drill ¾" Capacity

2BHT—3BHT Automatic Tape Controlled ¾" and 1½" Capacity

reduced from $24.39 to $5.36 per 100

(AT ZENITH CARBURETOR—DIVISION OF BENDIX AVIATION)

Automatic Hydraulic Turret Drills

In Addition:

1. 8 Burgmasters replace 18 Vertical Drills
2. 8 Fixtures instead of 18
3. Considerably less set-up time
4. Greatly reduced stock handling
5. Greatly reduced jig handling and jig storage
6. Greatly reduced floor space
7. Same machine used for several different sizes
8. Quick Set-up

Good tool processing, taking advantage of Burgmaster 2BH Automatic Hydraulic 6-Spindle Turret Drills, results in savings of $19.03 per 100 in machining cast iron carburetor fuel bowls at Zenith Carburetor Division of Bendix Aviation, Detroit, Michigan. Two banks of four machines each replaced the original 18 vertical drill presses used on this job. The line is now expanded to 12 Burgmasters. A series of operations, including center drilling, drilling, reaming, spot facing, pressing in bronze bushings, line reaming bushings, chamfering, and tapping are carried out automatically in two set-ups to complete the bowls in a minimum of time and effort. The first bank of Burgmasters produces 69 pieces per hour while the second bank produces 94 pieces per hour. The machines are pace setters, automatically doing the work and the thinking—requiring only loading, unloading, and starting by pressing a button.

This production record is made possible by the efficient automatic machine functions of the Burgmaster Model 2BH Turret Drills. The turret is power indexed, permitting skip indexing and selecting the desired spindle, speeds are preselected for each spindle, and pre-selective, infinitely variable feeds assure fine finish and accuracy. In addition, accurate micro adjustable depth control for each spindle is provided, and automatic rapid approach and return saves valuable machine time and speeds the machining cycle. All operations are performed at the most efficient rate commensurate with fine finish, accuracy, speed, and longest tool life.

Maximum Flexibility is Assured—

because all machine functions are adjustable, the machine can be set up with different tools and fixtures in approximately one to one and a half hours to produce other parts—automatically.

Burgmasters may be supplied as complete production units, including fixtures and tools ready to go into production. Manufacturers are finding they may be tooled to replace many different types of machines to effect substantial savings, increase production, and cut costs. Why not ask a Burgmaster field engineer to make recommendations on your work? There is no obligation.

Job Facts:

Machines—Burgmaster 2BH Automatic Hydraulic Turret Drills
Company—Zenith Carburetor, Division of Bendix Aviation, Detroit, Mich.
Part—Carburetor fuel bowls
Material—Cast Iron
Quantity—300 to 1500 per lot
Fixtures—Simple holding devices
Former Method—18 Vertical Drills requiring 18 fixtures
Former Costs—$24.39 per 100 units
Present Costs—$5.36 per 100 units
Savings—$19.03 per 100 units + 10 Fixtures, greatly reduced set-up time, stock handling, jig handling, jig storage, and floor space.

Write for bulletin describing Burgmaster 6 and 8 spindle Automatic Hydraulic Turret Drills in detail. Twenty-minute 16mm sound film showing Burgmaster turret drills in operation, including the new automatic positioning table, available from any office.

BURG TOOL
MANUFACTURING COMPANY, INC.
15001 South Figueroa Street, Gardena, California
Tel. FAculty 1-3510, TWX—Compton, California 6011

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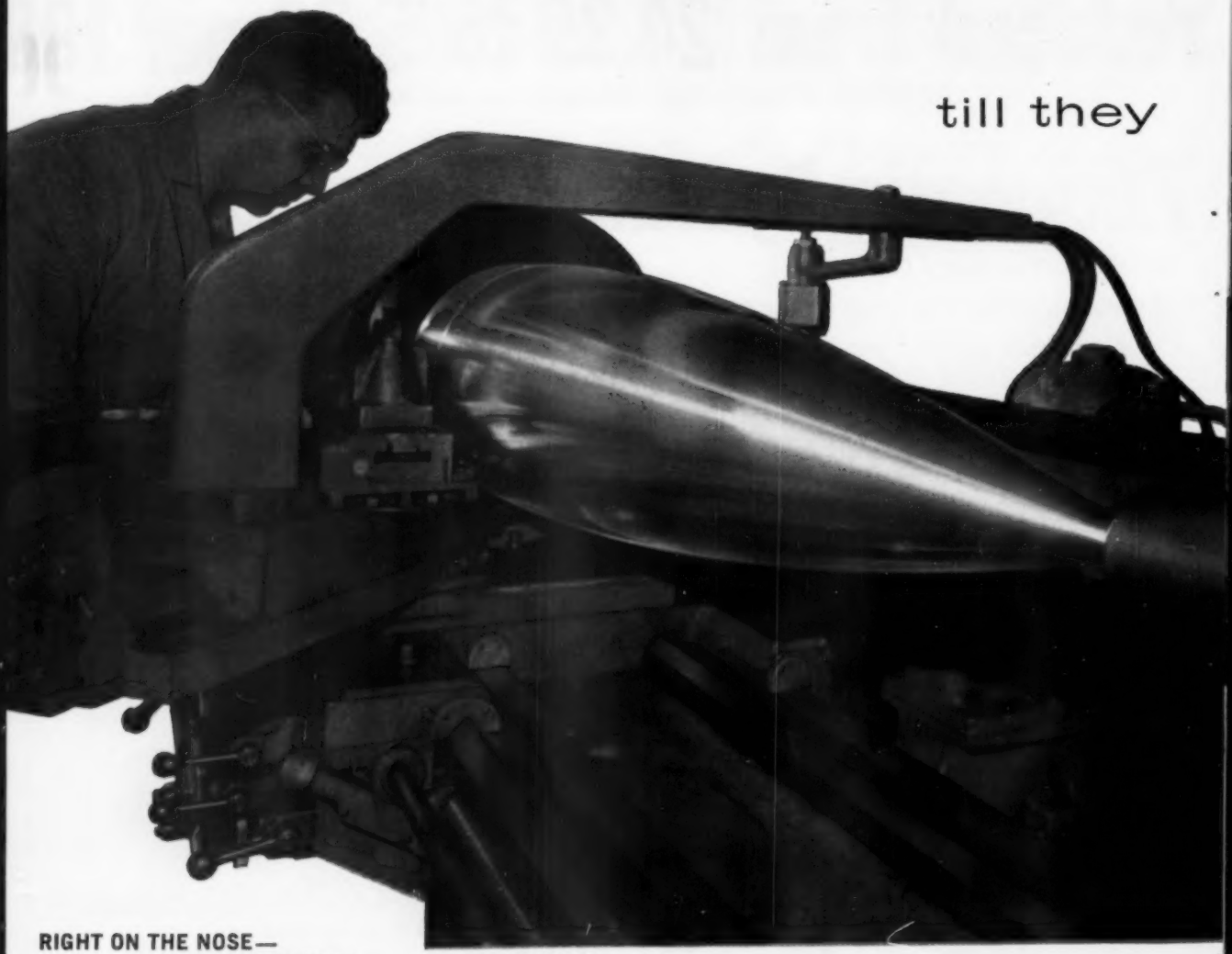
Plus dealer representatives in other industrial centers.

CIRCLE 240 READER SERVICE CARD

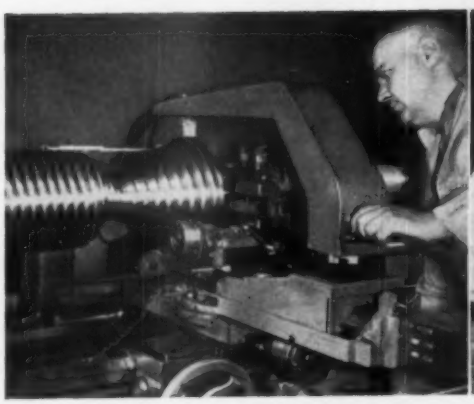
till they



RIGHT ON THE NOSE— AND EVERYWHERE!

Grinding complex missile shapes, in many cases, would be either costly, difficult, impossible or all three. Monarch Air-Gage Tracer users produce finishes of 17-18 micro-inches **regularly**—some of which are polished to 2-3 micro inches. Good enough—and no grinding problem! (Above—unretouched photo of die mold for plastic nose cone turned to a 16-18 micro-inch finish)

Monarch
TURNING MACHINES
FOR A GOOD TURN FASTER . . . TURN TO MONARCH



WHAT IT TAKES:

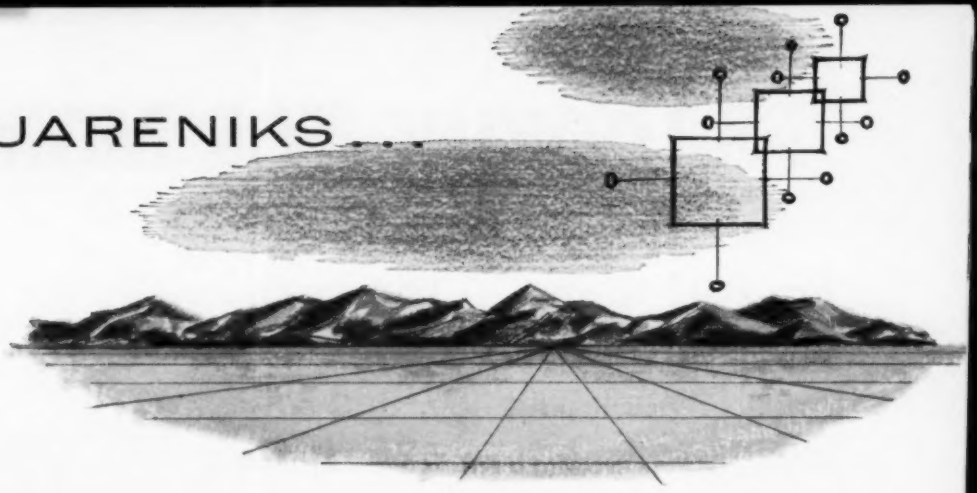
Air-Gage Tracer Control, Swiveling Action—a Monarch exclusive. Only with this equipment can you generate—in a single machining set up—the exacting, complex, often exceedingly thin-walled contours demanded by missile hardware. Tracer-controlled single point turning is mandatory for accuracy needed for critical parallelism, squareness and concentricity—and cheaper, too! (above a helix combustion chamber)

GREAT ON THE FACE OF IT

Numerous Monarch lathes afford you the advantages of constant surface cutting speed—so important to speed and finish in the facing of large, thin-walled work. Shown is a facing operation on a ram-jet turbine disc. Machine is a Monarch Model F Right Angle Lathe, swinging 60" in gap, equipped with Air-Gage Tracer Controls and constant surface cutting speed operating on both sides of center.

CIRCLE 241 READER SERVICE CARD

want SQUARENIKS...



THE MONARCH SWIVELING AIR-GAGE TRACER

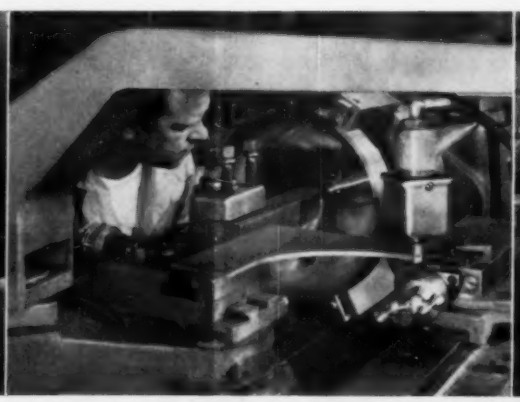
is a missile and rocket making "must"

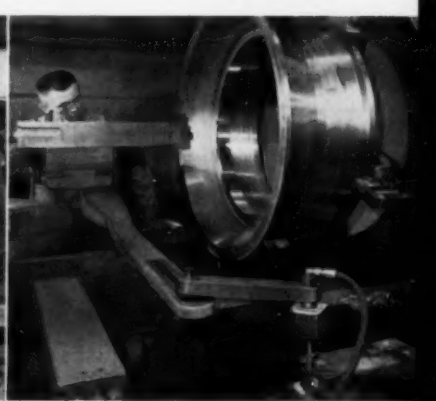
"Many jobs can be performed satisfactorily only on Monarch swiveling Air-Gage Tracer lathes," says one of the country's leading experts in the field.

Today, missile manufacturing is in its infancy. Even so, Monarch tracer lathes have proved themselves wherever used. And that is in most plants where missile components are being produced. Both swiveling and rigid types are employed. Adaptable to such work are all sizes from the small 10" Model EE to the largest Heavy Duty Lathes, plus the Mona-Matics and the Right Angle Lathe.

Profit by the experience of others. Check the applications pictured and described below. Then ask us for the whole story. Finally, remember we are talking about the same Air-Gage Tracer that is improving production and lowering costs in thousands of plants throughout metal working.

THE MONARCH MACHINE TOOL COMPANY • SIDNEY, OHIO





SELF-GAGING TURNING!

This rocket propellant chamber component is simple compared to some shapes. How's to gage them? Even expensive gaging fixtures can't always fill the bill. So what? With the close repetitive accuracy of Monarch Air-Gage Tracing, intricate parts are accepted based on the accuracy of the flat template used. Light (6-8 oz.) stylus pressure precludes template wear.

MULTI-THOUSAND DOLLAR QUESTIONS—AND EVERY ANSWER RIGHT!

What's to do when you spoil pieces in this business? Especially ones that might cost up in the thousands before machining (Not shown, but we've seen 'em!) Cut your throat? No—rely on the .0001" constant repetitive accuracy of your Air-Gage Tracer slide movement—and don't spoil any!

IT DON'T MEAN A THING IF IT AIN'T GOT THAT SWING

You need size in this business now—and they're designing bigger all the time. That extra-large work can be Air-Gage Traced overall on a Monarch. The turbine housing above is a typical example. But we're not stopping here. If present Monarch sizes don't meet your actual anticipated needs, let us talk over greater swing designs with you.

CIRCLE 242 READER SERVICE CARD

LOOKING FOR MORE FROM

For steelcutting . . . trim costs with Carboloy® Extra-Performance Grades 330, 350, and 370, and low-cost, General-Purpose Carboloy 78 and 78B carbides

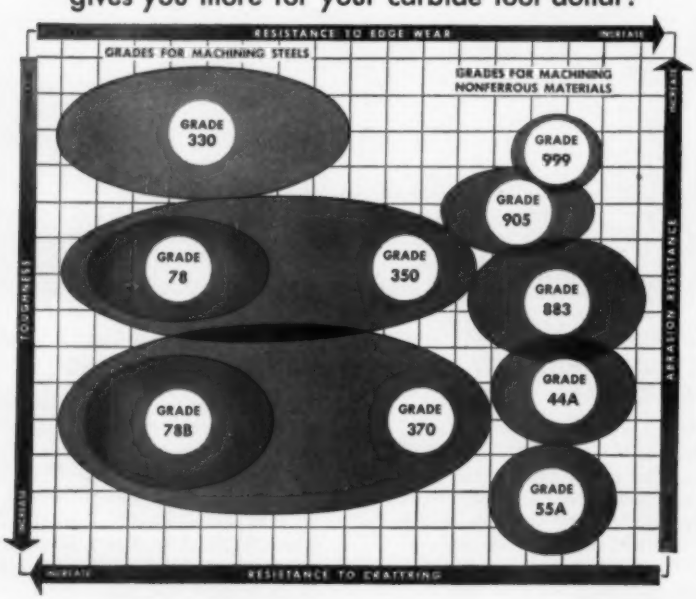
Some steelcutting jobs call for extra-tough, extra-performance carbides. Others can only be handled profitably with low-cost, general-purpose carbides. That's why we make them *both*.

Where you need increased machine productivity and have long production runs to keep cost-per-piece low—use Carboloy Extra-Performance Series 300 carbides. Their added strength and stamina handle jobs ranging from heavy roughing to high-speed finishing . . . at a unit cost and rate no "premium" carbide on the market can beat.

But, for general-purpose steelcutting jobs that don't require the Extra-Performance carbides, use Carboloy Grades 78 and 78B. Their top-notch performance, at low initial tool cost, will keep your machines operating profitably.

Chances are, your plant should be using *both* grades. Your local Authorized Distributor of Carboloy cemented carbides can deliver tools, blanks and inserts you need . . . in a hurry.

This complete team of Carboloy cemented carbides gives you more for your carbide tool dollar!



YOUR CARBIDE TOOL DOLLAR?

For nonferrous materials . . . boost production rates with Carboloy® cemented carbides performance-matched to your machining jobs

Aluminum, titanium, super alloys, wood—all have machining peculiarities that raise cain with production schedules and tool costs. That's why we make *five* job-tailored Carboloy cemented carbides for cutting these materials.

With these five grades (see chart, at left), you can get the one with exactly the right combination of shock resistance and wear resistance to match your job—whether heavy, interrupted cuts, or precision finishing.

Because you're using performance-matched carbides with consistent metallurgical quality, you can schedule heavier production loads . . . and you will get this increased output at lower tool-cost-per-piece.

Your local Authorized Carboloy Distributor has complete stocks of tools, blanks, and inserts in these five grades. A phone call to him today will get your machines humming faster tomorrow.

For more information on Carboloy Extra-Performance and General-Purpose carbides, or nonferrous material carbides, write: Metallurgical Products Department of General Electric Company, 11149 E. 8 Mile Road, Detroit 32, Michigan.

CARBOLOY®
CEMENTED CARBIDES

GENERAL ELECTRIC

KEEPS CUTTING FLUIDS
AS FRESH AS A DAISY

Here's why ELCIDE 75™ can increase the useful life of your soluble oil emulsions

Elcide 75 controls harmful bacteria that enter all oil-water emulsions and cause rancid odor, acidic corrosion, and emulsion breakdown. Prior to the development of Elcide 75, certain bacteria developed immunity to commonly used germicides, and no single inhibitor could control their damage.

Elcide 75 is a combination of proven anti-bacterial agents, including one of the safest and most powerful bacterial inhibitors used in the exacting field of medical surgery today.

Elcide 75 is not a "built-in additive" that is weakened by larger emulsion ratios. With Elcide 75 you know you have an effective, safe treatment because you add it to the emulsion right in your own plant.

Elcide 75 is completely safe for employees, machinery, and products. Not only is it non-toxic and harmless to sensitive skin, but its anti-bacterial action reduces the chance for infection caused by contaminated emulsions. The use of Elcide 75 also reduces the acidic corrosion caused by bacterial decomposition.

Bacteria cause emulsion trouble. This is a photomicrograph of *Pseudomonads*, one of the harmful types of bacteria found in oil-water emulsions. They enter the emulsion through the air, water, and plant debris, and make it possible for sulfate-reducing bacteria to cause odor, corrosion, and emulsion breakdown. Elcide 75 controls a much wider range of these and other types of damaging bacteria.

CIRCLE 245 READER SERVICE CARD

WHAT ELCIDE 75 MEANS TO THE METALWORKING INDUSTRY...

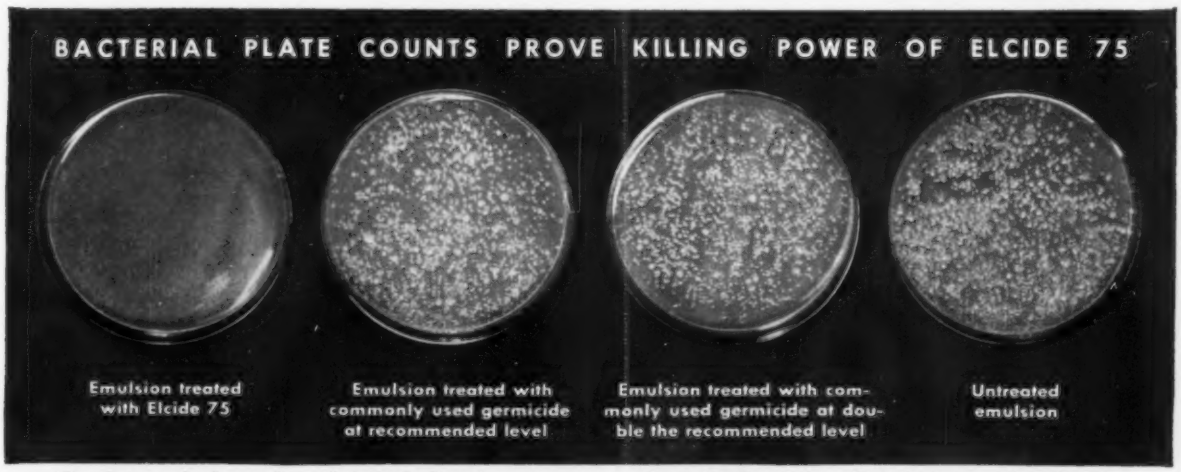
Operating costs can be greatly reduced because of Elcide 75. This saving is an accumulation of several important benefits.

Actual shop tests have shown that one ounce of Elcide 75 added to each four gallons of emulsion can keep the oil-water emulsion fresh as much as 5½ times longer. In one test, emulsions that normally had to be dumped at the end of four weeks ran for 22 weeks when treated with Elcide 75!

You can benefit by three direct savings—costly labor and down time for recharging will be reduced, your soluble oil requirements will drop, and the disposal cost of spoiled emulsions will diminish.

Elcide 75 also contributes to better products and longer machine tool life because it controls the bacteria which often cause acidic corrosion.

You can have a cleaner plant by using Elcide 75. It eliminates objectionable odors as well as bacteria that may cause skin infection. Elcide 75 is nontoxic and safe to use, as proved by tests conducted under normal shop conditions.


BACTERIAL PLATE COUNTS PROVE KILLING POWER OF ELCIDE 75
Emulsion treated with Elcide 75
Emulsion treated with commonly used germicide at recommended level
Emulsion treated with commonly used germicide at double the recommended level
Untreated emulsion

The photographs shown above illustrate the broad, powerful anti-bacterial action of Elcide 75. The light areas are bacterial colonies that have grown in three of the emulsion samples during 8 weeks' use. Note that none of these harmful bacteria appear in the emulsion treated with Elcide 75 during the same 8-week period. The emulsion stayed fresh.

PUT ELCIDE 75 TO WORK FOR YOU

The best way to determine the value of Elcide 75 to your own operation is to try it under normal plant conditions, using your regular oil-water emulsion. After you compare the costs of operation, you will agree that Elcide 75 is a valuable discovery that deserves a permanent place in your plant. Why not try Elcide 75 soon?

ELCIDE 75™

Lilly

PATENT PENDING

PRODUCT SPECIFICATIONS
ELCIDE 75

(Lilly's brand of bacterial inhibitor for cutting fluids)

Active Ingredients—Sodium Ethylmercuri Thiosalicylate (Thimerosal) and Sodium *o*-phenylphenate.

Package	Price per Gal.
1-gallon polyethylene	$8.50
5-gallon polyethylene	$8.00
55-gallon stainless steel	$6.50

This product is sold only through selected distributors.

For further information or to place your order, write or phone:

ELI LILLY AND COMPANY, AGRICULTURAL AND INDUSTRIAL PRODUCTS DIVISION, INDIANAPOLIS 6, INDIANA

TELEPHONE: MElrose 6-2211

Save Time with STANDARD STOCK BROACHES

Minute Man

KEYWAY BROACH KIT

In one minute and for as little as one cent you can cut a keyway with this kit. For keyways from 1/16" to 1" in any bore from 1/4" to 3".

Minute Man

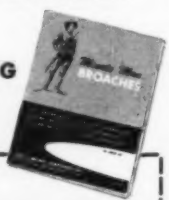
SQUARE BROACHES

HEXAGON BROACHES

***New* ROUND BROACHES**

Used in an arbor or hydraulic press for finishing holes to exact size in *one pass*. 1/8" to 3/4" squares and hex's; 1/4" to 1" rounds. Production Type Keyway Broaches also in stock.

SEND FOR CATALOG AND PRICE LIST



The duMONT CORPORATION
Greenfield, Mass.

MAIL FREE BROACH CATALOG AND PRICE LIST A describing Square Broaches, Hexagon Broaches, Production Type Keyway Broaches and Keyway Broach Kits to

Name.....

Company.....

Address.....

Letters...

To American Machinist
330 W 42nd St, NY 36, NY

Electrolytic grinding

Dear Sirs:
Re: your article, "How to Machine Difficult Workpieces," by C R Stroup, Vice President, Anocut Engineering Co of Chicago (*AM*—Jan 13 '58, p106).

The article showed no street or mailing address. We wrote to him, and the letter was returned. We are wondering whether you could furnish the complete mailing address, as we are quite interested.

John W Volkert
Rochester, NY

The address of the Anocut Engineering Co is 631 West Washington Blvd, Chicago 6, Ill—Ed.

Large gears

Dear Sirs:
In your article, "GE reveals how it makes large gears" (*AM*—Sept 22 '58, p113), you refer to a modified vertical gear hobber that performs as an involute gear checker.

Under the picture on p119, you say, "Individual cams for each diametral pitch control the motion of the stylus on the gear tooth profile checker."

This is strictly a misconception of the operation and design of this device, as actually the cam is completely independent of diametral pitch.

In theory, what actually has taken place is that we have developed a cam with the deviations of an involute curve from that of a given radius. As all involutes are proportional to each other, it is then readily understandable that the device is completely independent of diametral pitch.

The particular head shown in your article is capable of measuring involutes from 20-in. base diameter to 60-in. base diameter.

L S Pergande, *Field Engr*
Machine & Instrument Div,
Illinois Tool Works
Chicago, Ill

Rust proofing

Dear Sirs:
Reference is made to the last item on your "Spot News" page: "Ferrous metal parts can be rendered

SHOPMATES

N. Jarvis

... I CAN'T SEEM TO GET 'EM RIGHT ON THIS LATHE ... I JUST CAN'T MAKE THIS LATHE DO ANYTHING I WANT IT TO!!
THAT PROVES MY POINT... BEFORE YOU CAN MAKE A LATHE DO ANYTHING YOU GOTTA BE SMARTER THAN THE LATHE !!
N. JARVIS

This "SPECIALIZED" Leland-Gifford

DRILLS DEEP HOLES IN DIE CASTINGS

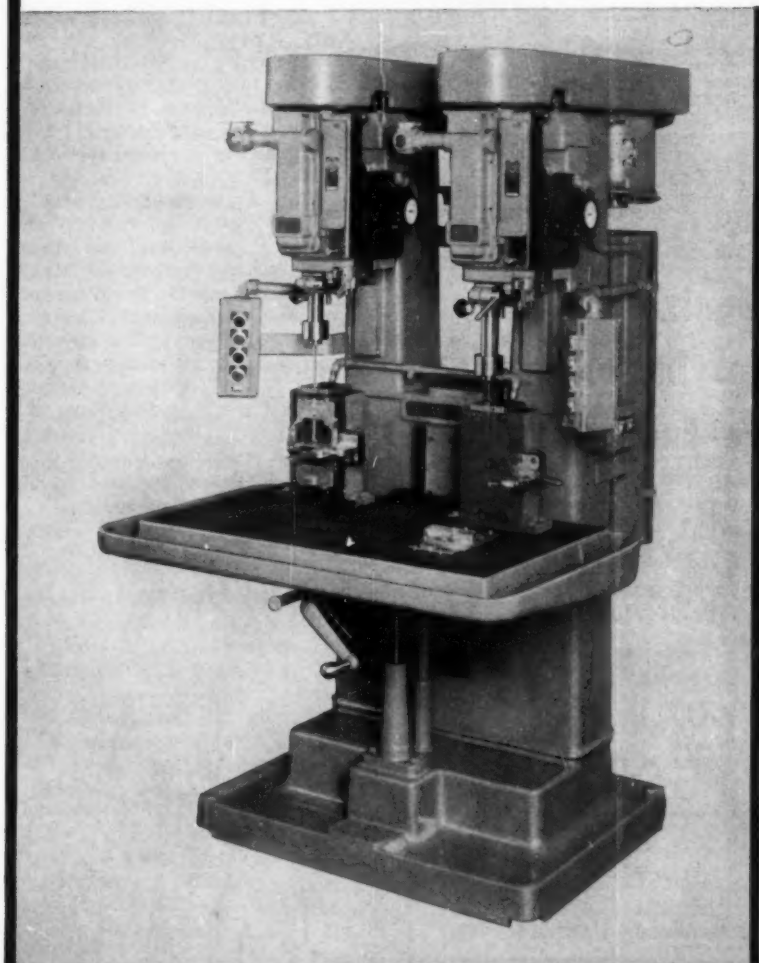
at 250 pieces per hour

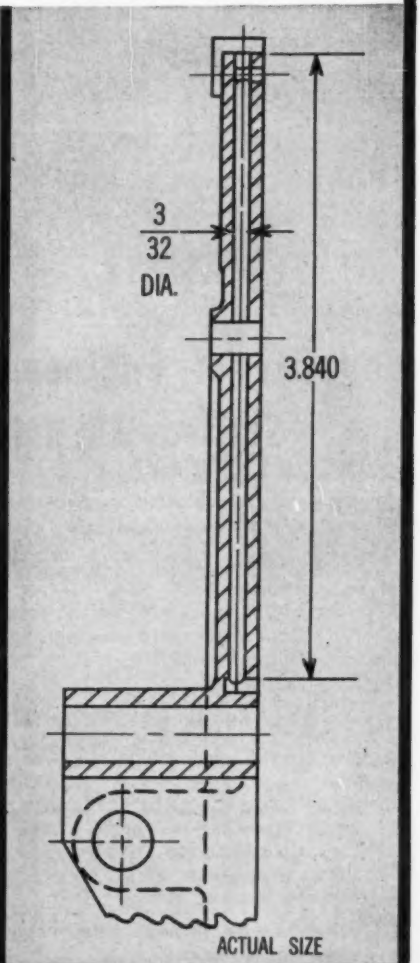
Small diameter deep holes . . . drilled to precise depth to meet an existing cross hole . . . through thin sections of die cast aluminum — this is a job on which you would settle for accuracy and not expect quantity production. But Leland-Gifford developed this two-spindle drilling machine that delivers both performance *and* production . . . proving once again that you never know how effectively a drilling problem can be solved until you talk to Leland-Gifford.

DO IT RIGHT and DO IT FAST...

Two self-contained drilling units are mounted on a standard pedestal over twin work-holding fixtures. Hydraulic feed with step by step control assures fast, automatic drilling to accurate depth and dimension.

Call in your nearby Leland-Gifford sales engineer.





LELAND-GIFFORD SPECIAL DRILLING MACHINES

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U. S. A.

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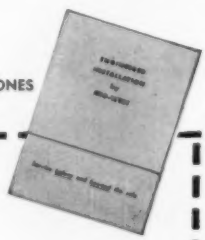
South Orange, N.J.
Los Angeles Office
2620 Leonis Blvd.
Vernon 58, Cal.
Indianapolis 6, P. O. Box 1051
Rochester 12, P. O. Box 24, Charlotte Station

. . . because both recognize the Unusual benefits of Engineered Installation by Skilled Abrasive Engineers

Mid-West is one of only three abrasive companies offering customers a complete line of abrasive products: sandpaper, grinding wheels, honing stones, abrasive grain and grinding machines.

Highly trained abrasive specialists—backed by constant research and testing, and the production of six plants—are "on call" by anyone having abrasive problems . . . whether it be old applications, new set-ups or quality control. Your call will bring one of our skilled Product Development Engineers without obligation.

MID-WEST ABRASIVE CO.
510 S. Washington St., Owosso, Mich.
MANUFACTURERS OF GRINDING WHEELS, SANDPAPER AND HONING STONES



Mid-West Abrasive Co.
510 S. Washington St.
Owosso, Michigan

Please send me, without obligation, a copy of *Engineered Installation by Mid-west.*

Name_____

Company_____ Title_____

Address_____

City_____ State_____

impervious to corrosion by dipping them for 5 minutes into a bath containing sodium nitrate" (*AM*—Sept 22 '58, p73).

Could you please inform us the name of the firm from which this news originated? We would like to find out more about the process and how it works.

H V Ross
Garwood, NJ

The news item came from our News Bureau in Bonn, Germany, and the release stated that the information came from Russian engineers. At the present, we know of no company here using this method—Ed.

Plastic panels

Dear Sirs:
Earlier this year you described some plastic panels (Haskelite) being used by the Burke E Porter Co in their plant expansion (*AM*—May 19 '58, p147).

We are very much interested in obtaining price information and literature covering these plastic panels from the Haskelite Manufacturing Corp. However, we cannot find their address.

We would appreciate any help you can give us in this respect.

Charles A Herman
Bay Shore, NY

The Haskelite Manufacturing Corp is located in Grand Rapids, Mich—Ed.

Helpful Henry

by L. Hoppes

"I'm holding them for some of the fellows 'til after you've passed by!"

CALENDAR

American Society of Mechanical Engineers — Annual Meeting, Nov 30-Dec 5, Statler and Sheraton - McAlpin Hotels, New York, NY.

Society of Automotive Engineers —Annual Meeting and Engineering Display, Jan 12-16, Sheraton-Cadillac and Statler Hotels, Detroit, Mich.

Plant Maintenance & Engineering Conference, Jan 26-29, Public Auditorium, Cleveland, Ohio.

American Society of Mechanical Engineers — Aviation Conference, Mar 8-12, Statler-Hilton Hotel, Los Angeles, Calif.

American Society for Metals—Western Metal Exposition and Congress, Mar 16-20, Pan-Pacific Auditorium and Ambassador Hotel, Los Angeles, Calif.

Society of Automotive Engineers —National Production Meeting, Mar 19-20, Sheraton-Cadillac Hotel, Detroit, Mich.

American Machine Tool Distributors Association—Spring Meeting, Mar 19-20, Sheraton Park Hotel, Washington, DC.

Society of Automotive Engineers —Aeronautic Meeting and Display, Mar 31-Apr 3, Hotel Commodore, New York, NY.

American Welding Society—Annual Convention and Meeting, Apr 6-10, Sherman Hotel and Donovan Hall, Chicago, Ill.

American Society of Mechanical Engineers—Metals Engineering Conference, Apr 29-May 3, Sheraton-Ten Eyck Hotel, Albany, NY.

American Foundrymen's Society —Engineered Castings Show, Apr 13-17, Sherman and Morrison Hotels, Chicago, Ill.

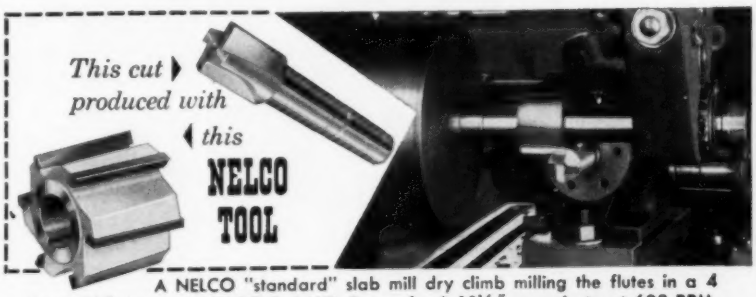
American Society of Tool Engineers — Annual Meeting, Apr 18-22, Schroeder Hotel, Milwaukee, Wis.

American Society of Mechanical Engineers — Production Engineering Conference, May 12-14, Statler-Hilton Hotel, Detroit, Mich.

HOW NELCO TOOLS MAKE NELCO TOOLS

Every machining operation on over 700 different NELCO TOOLS is performed more efficiently with a NELCO TOOL!

WHY?...because the versatility, machining speed, superior surface finish and dependability of NELCO TOOLS produce finer tools, more economically.



A NELCO "standard" slab mill dry climb milling the flutes in a 4 flute, 1½" diameter NELCO End Mill. Power feed, 10½" per minute at 600 RPM.

A NELCO "standard" 3" side mill dry conventional milling the flutes in a 2 flute ½" diameter NELCO End Mill. Hand feed at 640 RPM.

A NELCO "standard" 3 flute end mill dry conventional milling the carbide tip seats in a 2 flute ½" diameter NELCO End Mill. Hand feed at 2100 RPM.

These are but three of the hundreds of milling, turning, boring, reaming operations involved in producing over 700 "standard" NELCO TOOLS.

SEND TODAY for the new NELCO Catalog. Write: *Cutting Tool Division, Brown & Sharpe Mfg. Co., Manchester, Conn.*

FOR THAT EXTRA EDGE IN PRODUCTION

Brown & Sharpe

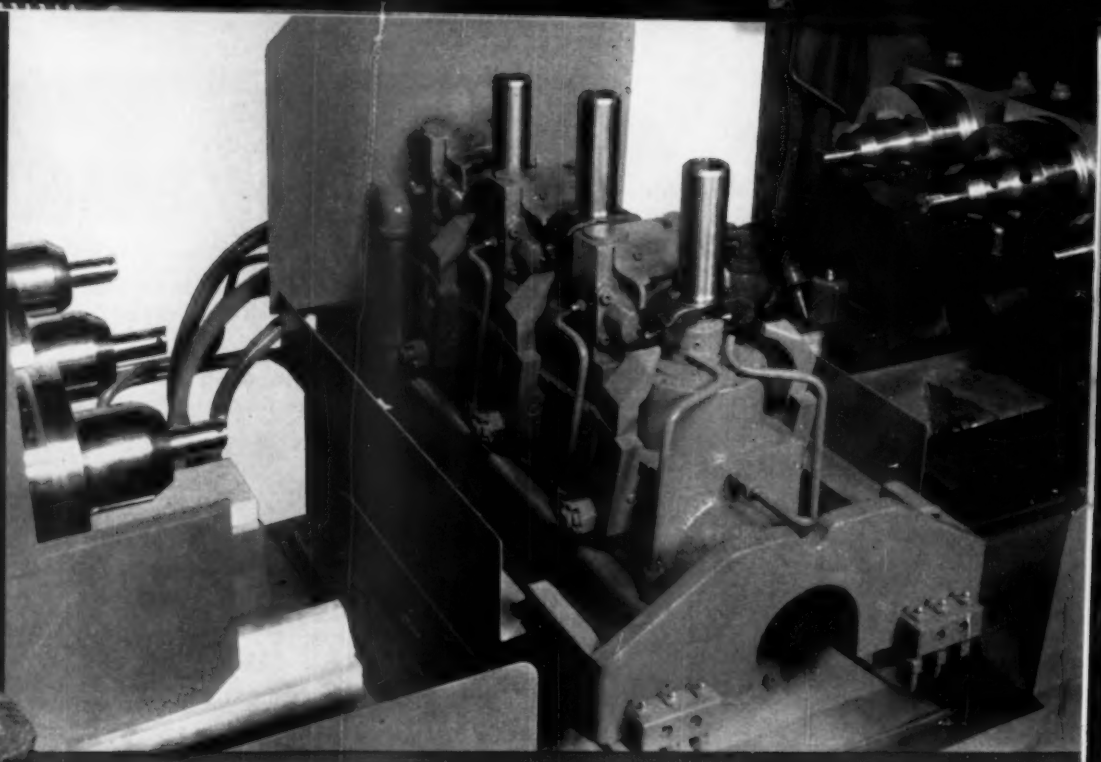
NELCO

HIGH SPEED STEEL CUTTERS
CARBIDE TOOLS

B·S

PROGRESS IN PRECISION FOR 125 YEARS

CIRCLE 250 READER SERVICE CARD



RIGHT: Vertical splined arbors and clamps holding shoulders of bores are operated hydraulically.

BELOW: Universal yoke showing two holes bored simultaneously.

Two-Way Boring Speeds Parts Production

58-9

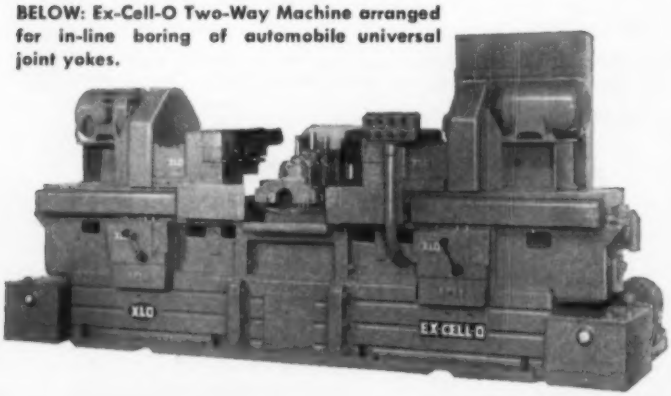
This Ex-Cell-O Precision Two-Way Boring Machine cuts production time of universal yokes for a manufacturer of automotive components by performing operations at both ends of a part—simultaneously.

Two independent machines interlocked electrically for central push-button control, the two-way unit bores two holes in line through malleable iron yokes held in a three station fixture. Both machine sections have three spindles on each slide for high production.

Two, three or four standard, self-contained way units can be easily arranged around a fixture at any angle the work requires. And like all Ex-Cell-O Precision Boring Machines, Way Machines are readily adaptable to different size workpieces—light, medium or heavy parts—and varying material requirements.

For complete information on versatile Ex-Cell-O Way Machines that can save time in your operation, contact your local Ex-Cell-O Representative, or write direct.

BELOW: Ex-Cell-O Two-Way Machine arranged for in-line boring of automobile universal joint yokes.



XLO EX-CELL-O FOR PRECISION

EX-CELL-O CORPORATION
DETROIT 32, MICHIGAN

Machinery Division

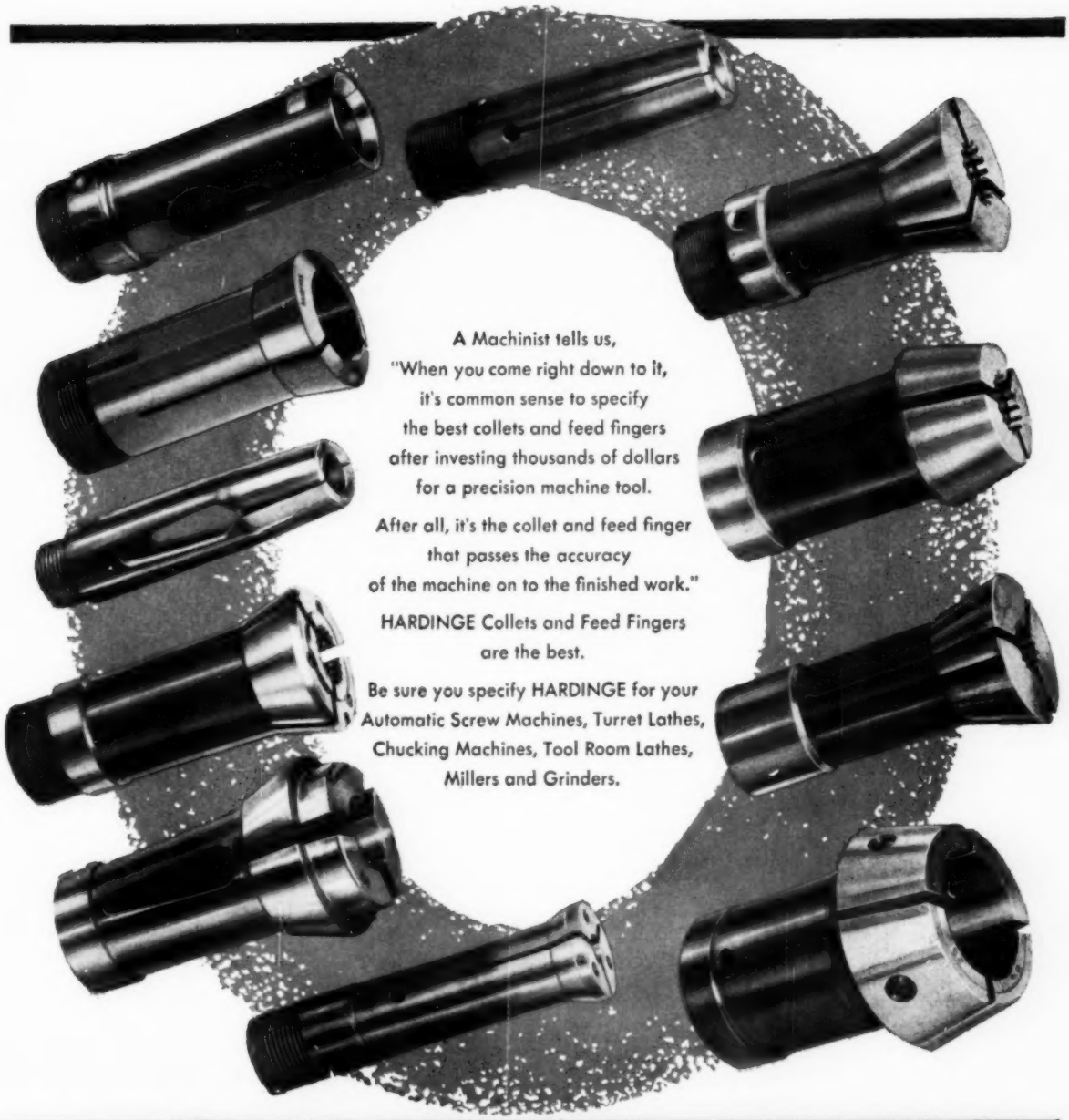
MANUFACTURERS OF PRECISION MACHINE TOOLS • GRINDING AND BORING SPINDLES • CUTTING TOOLS • TORQUE ACTUATORS RAILROAD PINS AND BUSHINGS • DRILL JIG BUSHINGS • AIRCRAFT AND MISCELLANEOUS PRODUCTION PARTS • DAIRY EQUIPMENT

CIRCLE 251 READER SERVICE CARD

Specify HARDINGE ELMIRA, N.Y.

Collets and Feed Fingers

and Get the MOST from your Investment in Machine Tools



A Machinist tells us,
"When you come right down to it,
it's common sense to specify
the best collets and feed fingers
after investing thousands of dollars
for a precision machine tool.

After all, it's the collet and feed finger
that passes the accuracy
of the machine on to the finished work."

HARDINGE Collets and Feed Fingers
are the best.

Be sure you specify HARDINGE for your
Automatic Screw Machines, Turret Lathes,
Chucking Machines, Tool Room Lathes,
Millers and Grinders.

HARDINGE BROTHERS, INC., ELMIRA, N. Y.

"PERFORMANCE HAS ESTABLISHED LEADERSHIP FOR HARDINGE"

Immediate stock delivery from Elmira, Boston, Atlanta, New York, Hartford, Philadelphia, Rochester, N. Y., Dayton, Detroit, Minneapolis, Chicago, St. Louis, Oakland, Los Angeles, Toronto, Montreal

Correct Lubrication in Action...

43,907 machine

In this dramatic operation, bundle of shafts, heated to nearly 1600°F., undergoes quenching bath. Action takes place at Transmission and Axle Division of Rockwell-Standard Corporation in Oshkosh, Wisconsin.

Mobil

Complete Engineering Program
Proved Petroleum Products

Mobil

SOCONY MOBIL OIL CO., INC., and Affiliates: MAGNOLIA PETROLEUM CO., GENERAL PETROLEUM CORP., MOBIL OVERSEAS OIL CO., INC.

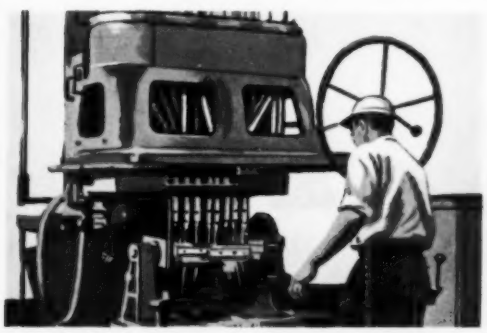
production hours saved!

In three years, Rockwell-Standard Corporation cut downtime over 36%—with the help of Mobil!

43,907 machine production hours! A worthwhile and profitable bonus. Rockwell-Standard Corporation's Transmission and Axle Division at Oshkosh, Wisconsin, made this saving through a Mobil Program of Correct Lubrication.

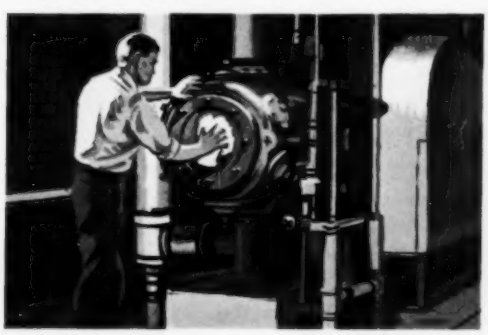
Plant maintenance engineers worked as a team with Mobil lubrication engineers. First, lubrication was put on a *scheduled* basis. This insured regular protection . . . cut thousands of repair hours. Oil contamination problems were solved . . . major repairs avoided. Mobil laboratories and Mobil specialists were called on for technical assistance.

In 1957 alone, this concentrated effort to reduce maintenance costs saved $33,063. In addition, dollars gained from increased production were many times this amount. This is *Correct Lubrication in Action!* Hundreds of plants have found it the answer to improved profits. Perhaps you will, too. Why not call a Mobil engineer and find out?

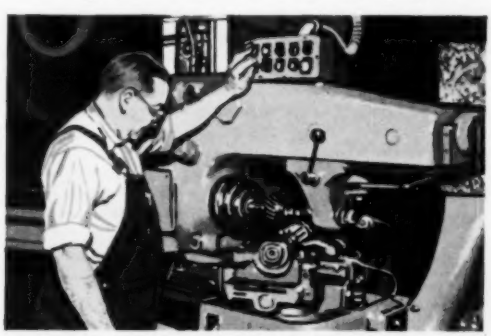


$19,520 saved on hydraulic-system maintenance. Valve failures caused severe production loss on multiple-spindle drills, boring machines and grinders. Mobil product solved problem . . . increased production by 4,000 hours per annum.

New storage and mixing tanks with automatic controls were installed as part of Mobil program. This system increased soluble-oil storage capacity . . . simplified oil purchasing . . . eliminated manual mixing of oil and water . . . saved $1,075 per year.



$3,000 air-compressor shutdown and overhaul avoided. Severe scoring was occurring in cylinder of vitally needed compressor. Mobil recommended oil that has kept compressor operating efficiently for past two years.



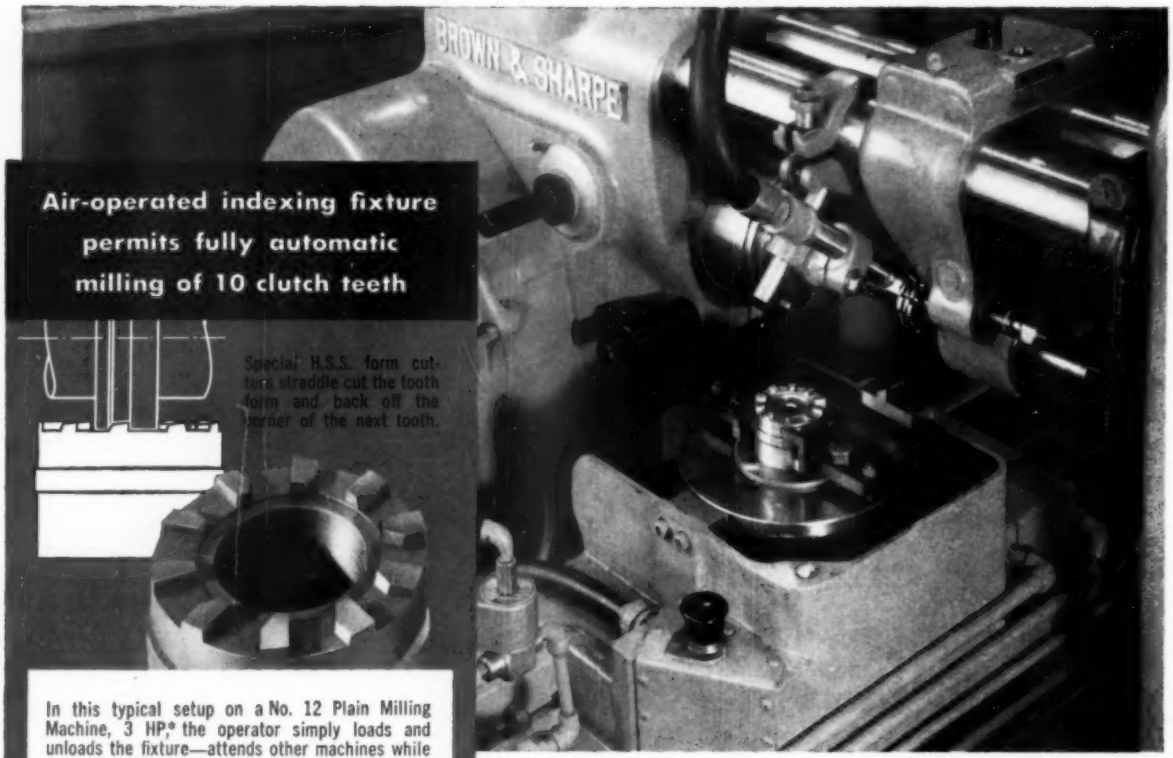
$27,225 saved on gear hobbers in 12-month period. Mobil and Rockwell-Standard personnel solved pump and fluid motor failures. New maintenance system reduced oil contamination, increased pump-motor life 400%.

Correct Lubrication

Another reason You're Miles Ahead with Mobil!

The BROWN & SHARPE No. 12 delivers

SPECIAL machine productivity with STANDARD machine economy



Air-operated indexing fixture permits fully automatic milling of 10 clutch teeth

Special H.S.S. form cutters straddle cut the tooth form and back off the corner of the next tooth.

In this typical setup on a No. 12 Plain Milling Machine, 3 HP,* the operator simply loads and unloads the fixture—attends other machines while indexing and cutting are completed automatically.

An air operated clamp, which holds the index table securely while the cut is being made, is released just before indexing. This clamp is also engaged manually, to prevent the work spindle from rotating, while loading or unloading the work.

The automatic cycle begins with advance of table in fast travel (300″ per min.). During this traverse, three micro-switches, contacted by special table dogs, activate the following: (1) the index cylinder is retracted to be ready for the next index, (2) a locking plunger positively positions the index plate, (3) the work spindle is clamped securely. The cutting feed is engaged automatically and, on completion of the cut, the table returns in fast travel. During this traverse, the micro-switches are activated in reverse order — unclamp, unlock, index.

This cycle repeats automatically until all teeth are cut. On the last index, an internal end-of-cycle switch is contacted, and after the last cut the table returns and stops for reloading.

By adjusting the stroke of the indexing cylinder and changing the index plate, different numbers of teeth can be cut, as required.

Part **Reversing clutch** *Material* **High carbon steel**
Cutter speed **220 RPM** *Feed rate* **7″ per min.**
Gross production **18 PIECES PER HOUR**
Former production **10 pieces per hour**

* Also available in 7½ and 10 HP spindle drive.

– more production per dollar invested

The operating features you need for fully automatic milling are *standard* in the Brown & Sharpe No. 12 Plain Milling Machine. By adding fixtures of special design, at relatively moderate cost, you can match the productivity of expensive single-purpose special machines.

Your equipment investment is lower, and you retain the unlimited adaptability of the basic No. 12 machine. It can be easily converted for revised operations, or to other jobs.

Brown & Sharpe specialists in fixture design will survey your operations and make recommendations at your request. Let them show you how to make your investment in production milling equipment pay the highest return in savings. For complete information, write: Brown & Sharpe Mfg. Co., Providence 1, Rhode Island.

PROGRESS IN PRECISION FOR 125 YEARS

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PRECISION TOOLS AND GAGES • MILLING, GRINDING AND SCREW MACHINES • CUTTERS
MACHINE TOOL ACCESSORIES • PUMPS AND HYDRAULIC PRODUCTS

SPOT NEWS...

- **Total number of machine tools in metalworking has declined** in the last five years—even though capacity has increased in the same period—it is reported in the Eighth American Machinist Inventory of Metalworking Equipment (pp Inv-1 to Inv-96). Two factors are responsible: (1) increasing use of special multi-station machines, and (2) a decline in machine tools over 20 years old.
- **Nationwide master listing of used machine tools for sale** will shortly be available for prospective buyers to examine at showrooms of every member dealer (240 of them across the country) of Machinery Dealers' National Association. The "Guaranteed Metalworking Machines Plan" will contain photographs and descriptions of machines valued at $1000 or more in inventories of all MDNA dealers. Each listed machine to be sold with a 30-day guarantee.
- **Local governments cannot levy personal property taxes on defense plants,** the California Supreme Court has ruled. Los Angeles County had collected $16 million in taxes on materials, machines and inventories of Aerojet-General and General Dynamics, will now have to refund the money.
- **A major U S automaker, it is rumored, plans to spend a "staggering amount"** over the next 5 to 10 years for purchase of electro-erosion equipment for die-sinking.
- **One U S maker of small tools** is exploring the possibility of having tools made in western Europe and shipped back here for sale. Even with import duty, difference in labor rates would make such a program profitable.
- **Red China's latest machine tool production claim:** 52,500 in the first nine months of 1958.
- **About 75% of the machine tools used in U S high schools are 10 years old** or more, the first survey ever taken of such equipment (part of *AM*'s 8th Inventory of Metalworking Equipment, p Inv-95).
- **Second round in the "who holds the patent on nodular iron" fight** has gone to International Nickel Co in a decision over Ford Motor Co and Caswell Motor Co Inc by the U S District Court of Southern New York to the effect that crankshafts made by Ford and sold by Caswell infringe Inco's U S Patent 2,485,760. Ford is appealing the ruling.
- **France's Renault has already delivered 100 transfer machine heads to Russia,** and another 400 are on order. The electro-mechanical heads are the most important components of Renault transfer machines for the automatic machining of internal-combustion engine blocks and heads.
- **Welding Information Center has just been established** by the American Welding Society at 33 W 39th St, New York City. The center will answer industry questions on welding and related fields, will also keep technical magazines abreast of newest welding developments.
- **South America's most modern truck plant has just reopened**—Mercedes Benz Argentine at Buenos Aires. The plant was mothballed with the collapse of the Peron regime. First job: to complete 800 chassis for small buses, on which work stopped more than three years ago.

Spot index to major News stories...

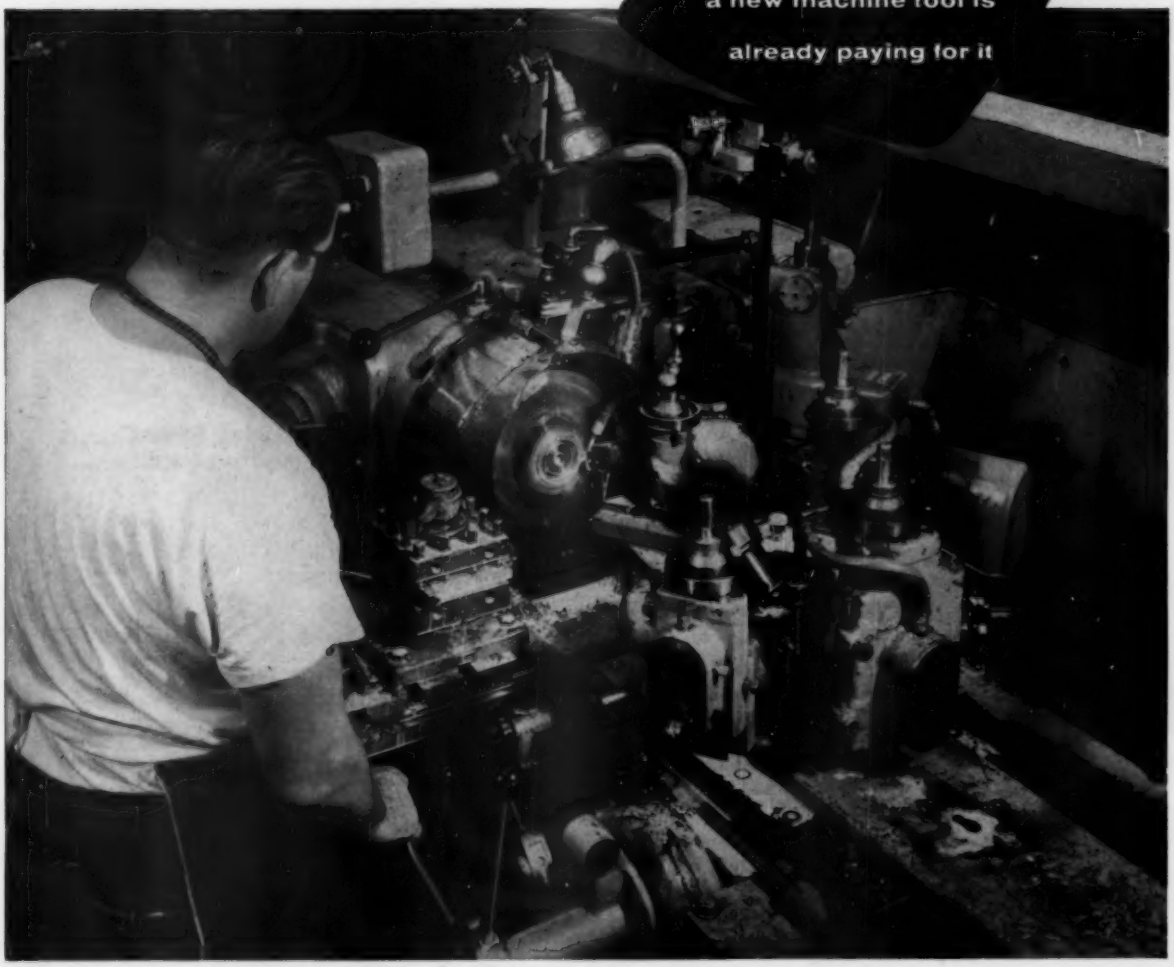
Revolution in metalforming? 123
Capital spending starts its comeback 125
Are outmoded tax laws industry's fault? 126
Are we preparing industrially for the wrong war? 127

Washington 107
Detroit 109
Aircraft & Missiles 111
Machine Tools 113
Materials 115

What's Ahead
in Metalworking 117
in Business 118
Field Report 289
Names in the News 325

JONES & LAMSON MACHINE TOOLS

the man who needs a new machine tool is already paying for it



Turret Lathe Tracing Pays off Double — and More!

It is hard to select the "best" feature of a J & L turret lathe which is equipped with a tracing unit. It could be the cost saving factor, as in the job illustrated above. Stainless steel forgings are first rough-machined with tools from the hexagon and square turret positions. Then, *in the same chucking*, the tracer is engaged and the parts are contoured to a 16 mu-in. finish at better than 1000 SFM. Manufacturing costs were cut 74%.

Another customer points out broader advantages. He says: "My turret lathe with its tracing attachment is the most versatile machine in my shop. It's a bar machine, a chucker, an engine lathe, and a shaft and cross-center duplicator, combined. No machine could do more, or produce more profits for me."

Write for detailed information. Jones & Lamson Machine Company, 502 Clinton St., Springfield, Vermont.

Turret Lathes • Fay Automatic Lathes • Precision Boring Machines • Thread & Form Grinders • Optical Comparators • Thread Tools

WASHINGTON...

Export licenses relax . . .

The Commerce Dept has announced that it is making a sweeping reduction in the so-called "positive list" of commodities which require individual export licenses for shipment to friendly countries. Among the items removed from the positive list and which now may be shipped abroad under general license are a substantial number of machine tools and other metalworking equipment.

The cutback in the positive list reflects last summer's decision of COCOM—the committee consisting of the NATO nations plus Japan which coordinates allied strategic controls on trade with the Soviet bloc—to relax East-West trade controls.

But the changes in the positive list do not directly affect US trade with Iron Curtain countries. The positive list merely contains trade items which cannot be exported to friendly countries without export licenses for individual shipment.

The purpose of the positive list is to make it easier for the government to block transshipment of the listed goods to the Soviet bloc through friendly countries.

Previously, any item on the positive list was automatically presumed to be banned for shipment to the Soviet Bloc. But now the assumption is that any of the deleted items *could* be shipped to Russia and her satellites—*if* the government will grant a separate license for individual shipment.

All US exports—with a very few exceptions— still require individual export licenses for shipment to the USSR and its European satellites, with the exception of Poland for which controls are looser. Trade with Red China, North Korea, North Vietnam, and Communist controlled Hong Kong is banned completely.

Although the reduction in the positive list does not affect trade controls with Iron Curtain countries directly, it does herald a more liberal government policy towards such trade. Commerce Dept will announce soon a broadening of the list of commodities which may be exported to the Soviet Union and the European satellites.

Here are the exempt items . . .

Metal-cutting machine tools and parts: engine and center lathes of over 18-in. center height and more than 18 ft between centers; automatic profiling and duplicating lathes; multiple-spindle automatic chucking lathes and between-center lathes; automatic multi-spindle bar machines; combination tube-boring and turning lathes.

Also non-automatic vertical boring and turning mills with 72-in.-and-over table dia, including vertical turret lathes; planer milling machines and combination planer and planer-milling machines with capacity for work 48 in. wide and over, or 15 ft long and over; horizontal-spindle, bed-type automatic milling machines with tables 20 in. wide and over or 48 in. long and over; thread millers (6-in. work dia and over at the thread); profiling planers for aircraft or marine propeller blades.

Also surface grinding machines that use wheels or abrasive-coated paper or cloth, as follows: multi-spindle, rotary table or workholder; horizontal spindle with reciprocating table over 24 in. wide; and multi-spindle disk.

Also roll grinding machines with or capable of being fitted with a cambering device; such other internal cylindrical grinding machines as centerless, automatic feed, automatic sizing, or with any other automatic features; automatic oscillating and race radial grinders, contour profile grinders, profiling grinders for marine and aircraft propellers, and thread grinders.

Also external surface broaching machines; attachments for center and capstan lathes, milling machines and vertical boring machines that make such machines capable of profiling and duplication.

Metalforming equipment: hydraulic gear-quenching presses, forging rolls, and forging machines capable of operating on bar stock of a diameter exceeding 3.5 in. or the equivalent cross-section.

Metalworking machines not otherwise classified: diamond wire-drawing dies, machines for flame-hardening gears, machinery for drawing and tempering (a) wire 0.015 in. dia or less, or (b) tubing 0.026 in. dia or less; and pneumatic gear-quenching presses.

New rules on defense contracts . . .

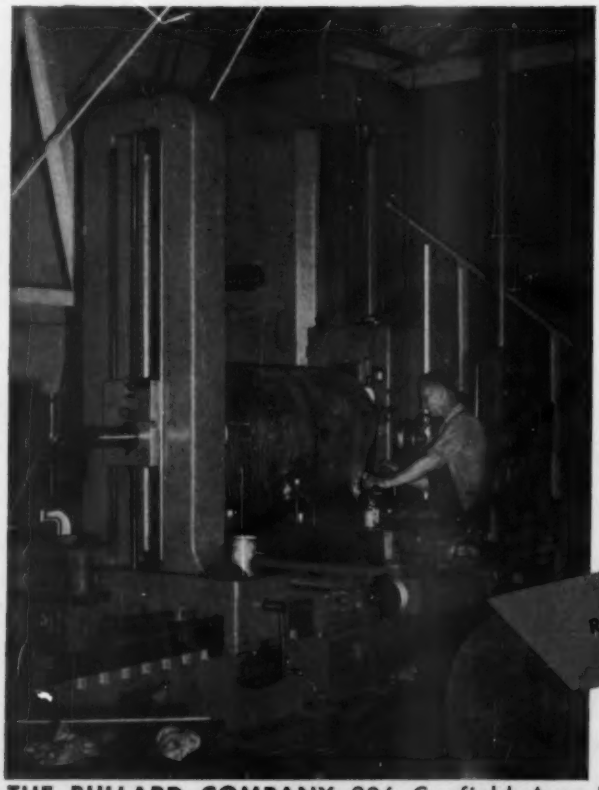
The Defense Dept will soon put out a new set of procurement regulations spelling out the types of cost to be allowed on military contracts. The revised rules, Section XV (Contract Cost Principles) of the Armed Services Procurement Regulations, are due out by January 1.

As the rules shape up now, itemized cost regulations will be applied both to cost-reimbursement type contracts and to fixed-price contracts in which costs are a factor in negotiations—contracts with price-redetermination and incentive provisions.

"To meet Today's and Tomorrow's Complex Machining Problems

we bought a . . . "BULLARD" H.B.M. model 75

This statement by Mr. Reed Clark, General Manager, C. & H. Machine and Engineering Company, Berkeley, California summarizes, after thoroughly investigating and comparing competitive machines, their conclusion.



If you are planning to purchase a horizontal boring machine, we invite you to compare, feature for feature, the Bullard H.B.M., Model 75 with other machines in its field. You will discover that — "To Cut Costs When Cutting Metal — Buy Bullard" — is sound advice.

A call to your Bullard Sales Representative or Distributor will bring you the complete story.

BULLARD

THE BULLARD COMPANY 286 Canfield Ave. Bridgeport 9, Connecticut

DETROIT...

Production up, sales ???

After the initial volley of optimistic forecasts based on dealer orders a strange quiet reigns. No sales manager wants to really commit himself on the coming year until dealers have adequate stocks.

For example, as of November 3, 700 of the nation's 1400 Imperial dealers had yet to receive their first 1959 model. Chrysler Division itself produced only 3870 units during October, a figure well below sampling minimums. The delay, of course, is the aftermath of the labor settlement.

Ford Motor Co was luckier in its timing because labor-caused shutdowns coincided in general with model changeover. It managed to produce 142,611 cars and trucks in October, its highest monthly output since January when 159,022 units were built. October production of 4673 Edsels and 29,649 trucks represented the best single month in 1958 for both lines. Calendar 1958 Thunderbird production is up tremendously over the previous year, too.

A clue to Rambler optimism comes from the fact that during this last October its dealers delivered 26,748 cars, compared to only 9680 for that entire month in 1957. The increase figures out to 176%.

All Ford plants are currently working at least a nine-hour day including Saturdays. Six-cylinder engine demand for Ford is such that this plant is on a 20-hour day.

Buick during the last week of October started a second shift to work in basic manufacturing facilities and within the week found it necessary to put final assembly on the same basis. In all, 3900 additional workers were recalled from a layoff that in most cases had lasted since last January.

"The decision to increase output again," General Manager E T Ragsdale said, "was dictated by a reappraisal of the market which shows the demand for our cars is up more than 100 per cent in some areas."

Overall optimism was reflected by University of Illinois Economist Hans Brems, who recently predicted that new car sales in 1959 may top six or seven million units. His estimate couldn't be an idle one—it was made before the cream of his fellow crystal ballists, gathered at the University of Michigan's Sixth Annual Conference on the Economic Outlook.

Generally conservative *Ward's Automotive Reports* forecasts 531,000 completions for November, noting that even Studebaker-Packard plans to double year-ago production on a six-day week basis.

Has auto engineering stopped?

An informal survey of Detroit area machine tool builders has so far produced no evidence of drastic engineering changes in 1960 models—such as a new engine or a trans-axle.

Yet orders for the latter are still expected, even though the program at the time of writing is two months behind normal schedules.

By the same token, Detroit and Cleveland tool and die shops are still waiting for orders to come through on the 1960 models, but so far only American Motors has set the ball rolling.

Probable reason for this is that the automakers, unlike last year, aren't being pushed by the threat of an industry-wide strike just as the 1960 models come out.

Jigs, dies and fixtures to boom . . .

Makers of tooling see boom years ahead. The main reason for this well-founded optimism is the commitment of Ford and GM to a yearly cycle of complete body change, made possible by generous interchange of basic stampings.

Ford will take the route of Chrysler with two basic shells, one for Ford, Edsel, and Mercury, and the other for Lincoln. This figure, of course, does not count the Thunderbird and the forthcoming small car. Mercury has only 1959 left to merchandise a body of its own.

There is no truth to the rumor that Lincoln will drop unit construction in 1960. The divisions had troubles almost throughout the 1958 model run, but these have been licked by a general beef-up, fore and aft.

Chrysler products will have all-new shells in 1960, but the possibility of their being unitized is now highly unlikely. The year 1961 now looks like the target date for that major step.

American Motors is starting to order dies for its big 1960 changeover. As before, a common shell will be used for regular-sized Ramblers and the Ambassador. The American won't change much.

GM, now firmly established with what may be loosely termed a single body shell, will cycle yearly. A move to unitized construction, once slated for 1961, is now tentatively programmed for 1963. Again, the single shell terminology used here does not include its small car, still definitely in the works for fall 1959 introduction.

Greenlee Transfer Machines can be Reworked to meet Product Changes

The Greenlee "Rearrangeable Unit" concept of transfer machine design is becoming increasingly popular in mass production manufacturing. These machines accommodate recurring changes in product design. Year after year they guard against costly obsolescence . . . they are changed to meet your changing requirements. Get the complete story from Greenlee.

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AIRCRAFT and MISSILES...

TRENDS

Boeing in court...

Trial has just ended in the U. S. Tax Court on Boeing's appeal from the Renegotiation Board's ruling that the company refund to the government $10-million gross profits earned in 1952. But it will probably be about a year before Tax Court Judge Graydon G. Withey comes up with a decision.

For both the government and the aircraft-missile industry, the Boeing case puts into the sharpest public focus ever the fundamental issues of the controversial Renegotiation Law. It involves the largest postwar renegotiation refund appealed in the Tax Court and comes in a new climate of sympathy—in Congress and elsewhere—for liberalizing the Act.

The Boeing case is also the first of a series of pending aircraft renegotiation appeals before the Tax Court. At least six other airframe makers have petitioned for recovery of over $50 million in refunds to the government before taxes under renegotiation.

North American Aviation, for instance, has filed an appeal on a $6-million gross refund for 1953 and $14 million for 1954. Lockheed has appealed a $6-million gross renegotiation refund ordered for 1953. Grumman has appeals pending on total renegotiation repayments of $10.5 million before taxes ordered for 1952-54. Republic Aviation and McDonnell Aircraft, however, haven't challenged refunds made for 1952.

Details on Boeing case...

In Boeing's case, the board ruled that of the company's $56.7-million gross earnings in 1952, $46.7 million was "reasonable profit" and $10 million "excessive." The company's sales for the year amounted to $737.5 million. Boeing is petitioning to recover a net sum of $2.9 million already refunded to the Treasury on the excessive profit ruling. Tax credits for the year cover the remainder of the $10-million.

Boeing argued that $5.8 million of its 1952 profits before taxes came from incentive-type production contracts, that in effect the Renegotiation Board is penalizing the company for its efficiency in reducing manufacturing costs.

The company also argued that it's entitled to realize a greater profit on 1952 defense business than the Board allowed because of the Air Force's decision to put Douglas and Lockheed into B-47 production—utilizing jet trade secrets developed by Boeing.

U. S. Trial Attorneys pooh-poohed Boeing's claim, contended that the forced sharing of Boeing's jet secrets with its competitors was justified since the development work was done under military contract. They also stressed that renegotiation determinations of excessive profits are made, under law, on all company receipts for the year, and that incentive-type contracts are not exempt from the Renegotiation Board's rulings.

Britain loosens plane credit...

Feeling that its aircraft industry is losing foreign sales to U S makers because of easier American credit terms, the British government has just extended its credit limits to seven years, instead of five as before, to foreign purchasers of British civilian aircraft and aircraft engines. In this way, Britain now matches terms offered by America's Export-Import Bank. Prime reason for the move: only two foreign airlines have thus far placed orders for the Comet 4; only one for the new Vickers Vanguard turboprop; and none at all for the Vickers VC-10 and DeHavilland DH-121 jets.

Germans here to buy fighters...

A West German Defense Ministry team has just asked permission to visit Lockheed and principal vendors for the Lockheed F-104 Starfighter—with an eye to purchasing six to 10 planes, which will be used as models for German firms to manufacture 300 more under license. If talks with Lockheed prove unsuccessful, the Germans may approach Grumman with a similar offer.

This is a prime move in putting Germany back into military plane production on a large scale. Also under consideration by Germany is purchase of 50 Fiat G 91s from Italy, to be licensed for production in Germany, too.

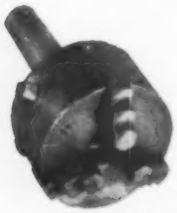
Around the industry...

- Hughes Aircraft has settled with 14,000 hourly workers of Local 1553 AFL-CIO for a new three-year contract calling for increases of 4¢ to 7¢ per hour, effective November 15, plus more hospital and vacation benefits.
- Burroughs Corp has just received a $22-million USAF contract for purchase of 12 more data processing systems for SAGE.
- Republic Aircraft reports it has shaved more than $3 million from estimated costs of producing the F-105 fighter bomber in six months by employing 353 company-originated cost-cutting ideas and suggestions. Even bigger savings are expected for second half of 1958.

CHUCKS CAN BECOME OBSOLETE TOO!

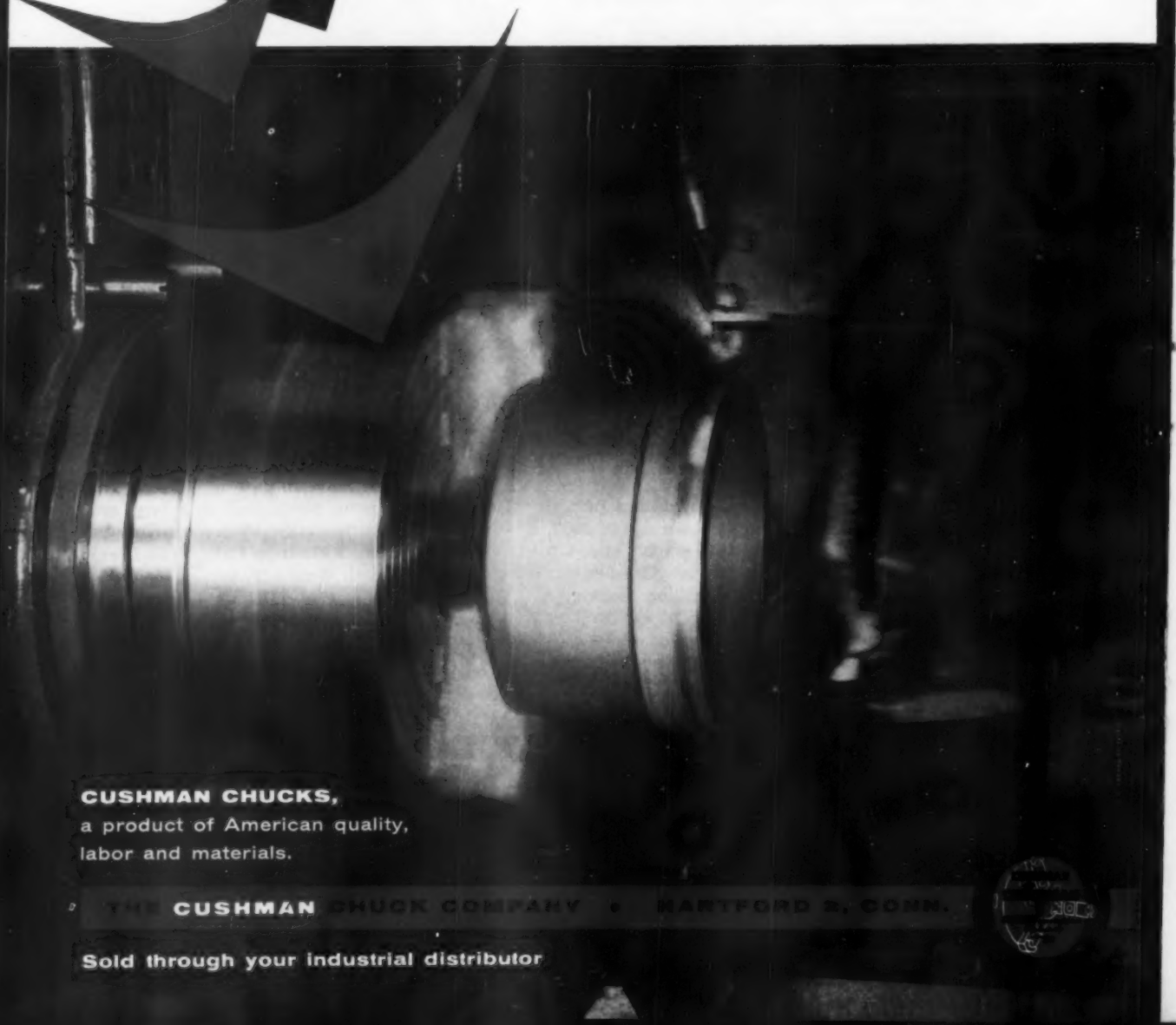
retool with Cushman

air or manually operated chucks



Designed and built to fully meet modern machining techniques and machine tool requirements, Cushman Chucks permit the use of higher speeds with heavier feeds, maintaining closer tolerances with continued repetitive accuracy and result in maximum workholding efficiency with the greatest savings in time and costs.

For profitable machining through the use of precision chucking equipment, specify Cushman Air or Manually Operated Chucks.



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a product of American quality,
labor and materials.

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Sold through your industrial distributor

MACHINE TOOLS...

Pickup in inquiries...

Hopes for a pickup in machine tool business are based more on the volume and apparent urgency of inquiries than upon net orders now coming in. The widely anticipated fall improvement in bookings has not yet materialized, except among a relatively small number of builders.

These views were expressed at the recent meeting of the National Machine Tool Builders' Association at Hot Springs, Va.

The feeling is that any increase during the remainder of the year is likely to be minor. But hope is high that the first quarter will get net orders off dead center, where they have been for months.

Soviet market glut feared...

Fear that the Russians will begin flooding the world with machine tools was expressed by members of the European Committee for Cooperation of the Machine Tool Industries when they met with an NMTBA committee recently in Brussels, Ludlow King, executive vice president NMTBA, reported at Hot Springs.

Through her satellites (Czechoslovakia especially), Russia has started selling machine tools in South America and in Europe at one-third to one-half below European-produced machines.

Russia's tremendous advantage, Mr King pointed out, is her ability to sell in capitalist markets for capitalist currency machines produced with Communist labor, where costs do not establish the selling price.

Sales of Communist machine tools will be used as a political instrument of destruction—the end of strong machine tool industries of the Free World. Mr King made the comment that "the new Russian threat might give our friends (Europeans) a keener insight as to how we feel when they raid segments of our domestic markets, and why we plan to do everything possible to protect our industry."

England, Germany and Italy will produce over $1 billion of machine tools (adjusted to US prices) in 1958, compared with our $480 million, Mr King estimated. Their export business alone ($450 million) will be close to U S entire output, he said.

"Our ability to out-design, out-service and outsell cheap labor countries, and our government's interest in maintaining a strong machine tool industry are the two factors upon which our U S industry depends" in the face of low-wage competition from abroad, Mr King pointed out. **Superiority of U S builders' ingenuity,** creativeness and technology has pulled the industry through difficult circumstances before.

Changes at Cincinnati Milling...

Walter W Tangeman, after completing 50 years of service to the Cincinnati Milling Machine Co, has retired as chairman of the board, but will continue as a director. Frederick V Geier, president since 1934, will succeed Mr Tangeman as chairman and will also be chief executive officer of the company.

Swan E Bergstrom has been elected president. Since 1956 he has been executive vice president and prior to that served as district manager, sales manager and Machine Tool Division manager successively. He joined the company 31 years ago.

Sundstrand buys Hanson-Whitney Division...

Machinery Division of Hanson-Whitney Co, Hartford, Conn, has been purchased by Sundstrand Machine Tool Co, Rockford, Ill, which will manufacture the Hanson-Whitney thread miller in its Belvidere, Ill, plant near Rockford. The Hanson-Whitney name will be retained for the thread miller.

This is the second purchase by Sundstrand of a machine tool company within the past year. Arter Grinding Machine Co, Worcester, Mass, sold its line of machines to Sundstrand and the Arter company went out of business.

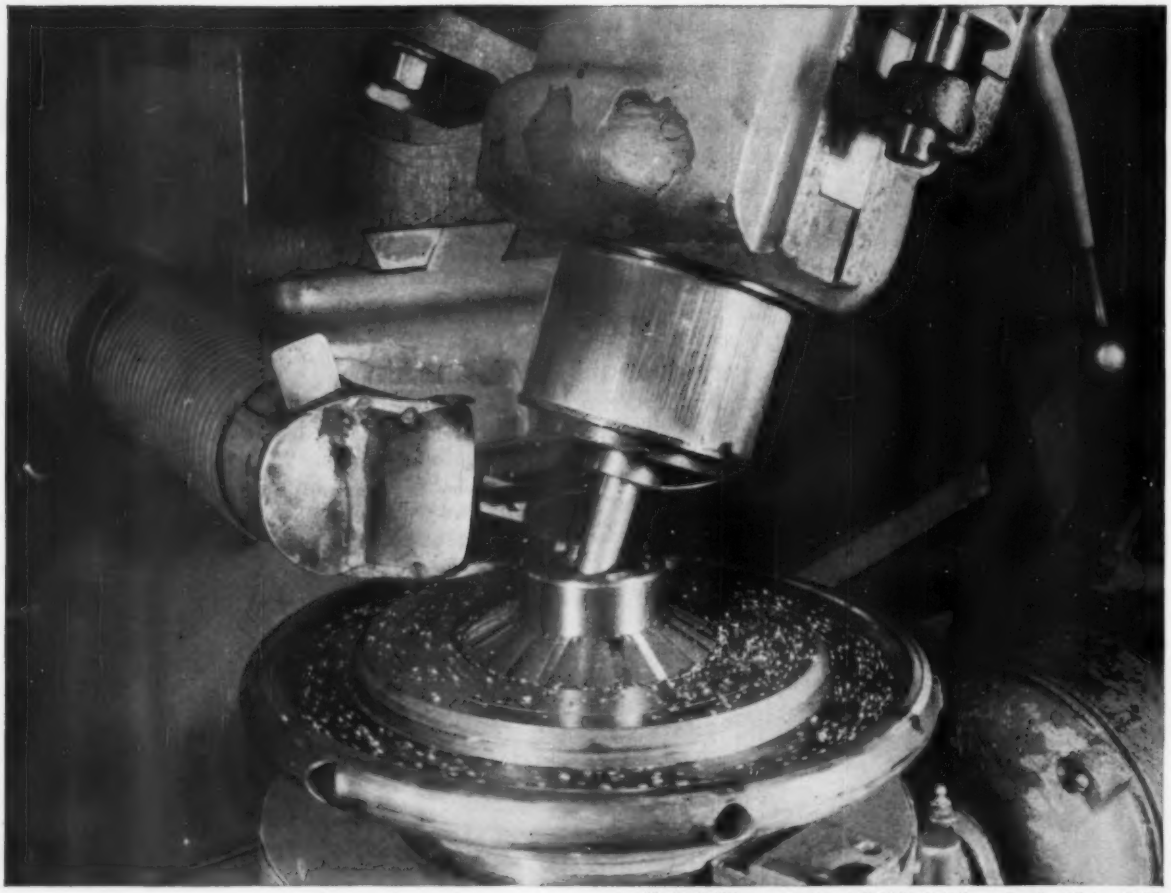
Sixth European Show to Paris...

The Sixth European Machine Tool Exhibition will be held in Paris from September 12 to 24, 1959, in a new modernistic exhibition hall called Centre National des Industries et des Techniques (France's National Industrial and Technical Center).

Capped by the world's largest thin-shell roof, the hall will provide more than 1 million sq ft of floor area. It is located in the suburb of Puteaux, on the edge of Paris. It was conceived and financed by a group of French industries.

Though the new exhibition building is not as large as the combined space in the series of buildings at Hanover, Germany, it has the merit, among other features, of enabling visitors to see the entire show under one roof. The recent Mecanelec exhibition, with 650 stands on the ground floor and first mezzanine, was held there, even though the building was not completely finished.

BF



Vertical milling operation at Fluid Packed Pump Co., Los Nietos, Calif.

SAVE...

with fast-machining steels from Ryerson

It will pay you to let a Ryerson representative help you select the steel best adapted to your operations. The Ryerson man can document cases of improvements up to 50% in parts machined per hour . . . of increases in tool life of 300%.

The nation's largest stocks of fast-machining steels of every type, including the carbon, alloy and stainless steels listed at right, are on hand at Ryerson ready for quick delivery. Call the Ryerson plant near you.

FREE-MACHINING STEELS IN STOCK

Ledloy® steels & screw stock—Ledloy rounds up to 4", squares up to 1½" and hexes up to 3". Also on hand—all your requirements for C1213, MX1213, and leaded and non-leaded C1117 and C1141.

Carbon steel tubing—All the sizes and wall thicknesses used by automatic screw machine shops are ready for shipment, including the new Ryerson development, lead-bearing seamless mechanical tubing.

Alloy bars—Complete selection of leaded alloys, including the Rycut® steels—fastest machining in their carbon ranges.

Stainless bars and tubing—Here, too, our stocks are the nation's largest including easy-machining Types 303 and 416 in rounds, hexagons and squares.

Carbon steel plates—New E-Z-Cut® Plates (Hot Rolled, Low Carbon Manganese).

RYERSON CERTIFIED QUALITY

RYERSON STEEL®

Member of the INLAND Steel Family

Principal Products: Carbon, alloy and stainless steel—bars, structurals, plates, sheets, tubing—aluminum, industrial plastics, metalworking machinery, etc.

JOSEPH T. RYERSON & SON, INC. PLANTS AT: NEW YORK • BOSTON • WALLINGFORD, CONN. • PHILADELPHIA • CHARLOTTE • CINCINNATI • CLEVELAND DETROIT • PITTSBURGH • BUFFALO • INDIANAPOLIS • CHICAGO • MILWAUKEE • ST. LOUIS • LOS ANGELES • SAN FRANCISCO • SPOKANE • SEATTLE

MATERIALS... TRENDS

Special metals...

Engineers at The Brush Beryllium Co (Cleveland) tell us that the company now is in full production rolling high-purity beryllium for the US Air Force program. Northrup Aircraft Co is doing some work on extruding this material under a similar USAF contract and Ladish Drop Forge is working at forging it. Casting methods are being studied at Armour Research Foundation and surface effects are being researched at Lockheed Aircraft Corp.

Titanium alloys can be quenched directly from the forging hammer or press, according to a paper read at the ASM Metal Show by Leonard S Croan and F J Rizzitano of Watertown Arsenal. Normally these alloys are forged at temperatures under 1750 F to avoid embrittlement.

Forging costs are increased because of these relatively low temperatures because of the difficulty of filling dies and excessive die wear. High-capacity equipment is needed and rejects are numerous.

Now, by quenching directly, forging is possible at temperatures as high as 2200 F with very little loss in ductility and an actual increase in impact strength. Fewer heating and forging operations are required and parts impossible to make at lower temperatures have been forged.

Looking to the development and manufacture of major components for outer-space vehicles, guided missiles and atomic energy, the American Metal Products Company's Engineering-Science Div at Ann Arbor, Michigan is devoting a sizable effort to developing high-temperature materials. Andrew M Mras, president, expects that patentable products for the commercial market will result from this research. American Metal Products is seeking diversification from a largely automotive market.

Temperature-resistant titanium...

Ultimate tensile strengths of about 100,000 psi at 1100 F are claimed for normal use, with strengths of 50,000 psi available at 1400 F, with Mallory-Sharon's new Titanium alloy MTS 881. The company expects this capability to enlarge the market for titanium in missiles and aircraft. Significant as a skin material, no figures were released on the new alloy's welding qualities—but Mallory-Sharon says preliminary tests look good.

Alloying elements of MST 881 are 8% aluminum, 8% zirconium, and 1% tantalum and columbium. So far, it is thought that the new alloy will be used in Mach-3 jet engines and missile casings. M-S and Aerojet-General are studying the alloy for possible use in the Navy's Polaris missile. Titanium has proved an excellent metal for salt-water applications.

Foamed aluminum...

"Foamalum" is the name given to a line of foamed aluminum materials developed by Foamalum Corp, LaSalle, Ill, as a sandwich filler alternate to honeycomb.

Suggested applications include: core material for doors, laminated and sandwich panels, acoustical ceiling tile, wall panels, store fronts, docks, piers, signboards, sports equipment, high-temperature-fuel floats, aircraft and civilian furniture, novelties, toys, boat and automotive parts.

Originally developed under an Air Materiel Command contract, Foamalum had good rigidity. It also is malleable. It floats in water, not because of its skin surface, but because a major portion of its cells, or bubbles, are closed. They will not absorb water, even with the skin removed from the coating. Pressing the foam to shape (originally it is cast) does not destroy the cell structure. It merely changes cell shape. Little or no splitting or shattering occurs.

The foamed material picks up strength as it is compressed. Thus the original ingot strength is obtained when only one-half of the original density has been reached.

One sample of Foamalum, with a density of 40 lb per cu ft, was tested for thermal conductivity. It measured 17.7 btu per in./ft²/hr/deg F. This compares with 1450 btu for solid aluminum. Thus foamed aluminum has a heat loss roughly 1/80th of solid aluminum, with one-fourth the weight of solid aluminum.

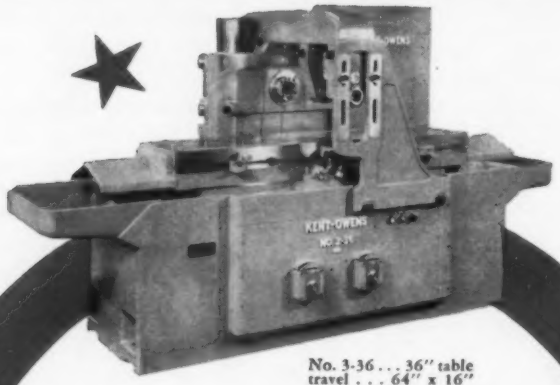
Additive improves lubricants...

Manganese organometallics, the same group of compounds that shows great promise as antiknock agents in gasoline, may provide a series of additives which will improve the anti-wear qualities in lubricants and cutting oils.

According to Morton Antler of Ethyl Corp, research indicates that these compounds can be very effective in reducing the friction and wear of rubbing metals. They form protective films without surface attack and provide lasting protection by depositing a clinging film that even improves lubricants used in later operations. Effectiveness of the organometallics improves as the hardness of the metal increases.

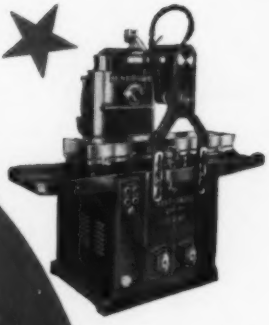
Every one a Star

for speedy accurate milling!



No. 3-36 . . . 36" table travel . . . 64" x 16" table . . . full automatic hydraulic feed.

No. 2-20DS . . . Double Spindle for two milling operations . . . 20" table travel . . . 42" x 12" table. Hydraulic feed.



No. 2-20 . . . 20" table travel . . . 42" x 12" table . . . full automatic hydraulic feed.

You'll turn out milling jobs with stepped up speed and accuracy with the work on Kent-Owens Machines! These extra-rugged Millers are performance-proved . . . simple . . . versatile . . . practical in every detail. Advanced features throughout! Twin-post head mounting assures balanced load. Only two gear contacts, motor to spindle, means greater cutting efficiency. Check your needs! Write today for bulletins on wide range of hydraulic and hand-operated machines. Also, let Kent-Owens design and build your tooling and special machines. Kent-Owens Machine Co., Toledo, Ohio.

No. 1-14 . . . 14" table travel . . . 32" x 9" table . . . hydraulic table feed . . . full automatic cycle.

No. 1-M . . . Hand feed to table and head . . . 25" x 9" table travel . . . head counter-balance is adjustable.

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KENT-OWENS

for milling machines

KENT-OWENS REPRESENTATIVES

BOSTON
General Machinery Corp.

BUFFALO
Beasley-Hofmann Mach'y Co.

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CLEVELAND
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Hester Machine Tool Co.

DAYTON
C. H. Gosiger Mach'y Co.

DETROIT
A. C. Haberkorn Mach'y Co.

FT. WAYNE
Ottis Machinery Co.

GRAND RAPIDS
Joseph Monahan & Co.

HAMILTON, ONT.
F. F. Barber Mach'y Company

HARTFORD
Harrington-Wilson-Daum Corporation

HOUSTON
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Ottis Machinery Co.

KANSAS CITY
Eichman Machinery Co.

LOS ANGELES
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MILWAUKEE
Four States Mach'y Company

MINNEAPOLIS
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SEATTLE
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SYRACUSE
J. F. Owens Mach'y Company

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WINDSOR, ONT.
F. F. Barber Mach'y Company

WHAT'S AHEAD... in Metalworking

TRENDS

Metalworking production picks up steam . . .

More and more metalworking industries are reporting pickups in orders, and the outlook is brightening for many others as slow-starting 1958 draws to a close.

Leading the recovery parade are the consumer durable goods industries, with some basic industries, historically slower to go into a recession and slower to come out of it, reporting increases in new orders and shipments.

The automotive industry has snapped out of its many-months-long doldrums with a vengeance, carrying with it the dozens of industries that supply it with parts and materials.

This is also true of the appliance industry, which in less than three months has not only come out of a long depressed period, but has reversed its usually low fall sales trend.

Production schedules, particularly for refrigerators, freezers and home laundry equipment, are being upped almost month by month as orders continue to pour in so fast that long-over-stocked dealers are calling for more appliances to fill inventory gaps. Also moving well are dishwashers, and, at last, television sets.

Farm machinery manufacturers are still dazed from the fast comeback their production has made in the last few months. Like the automotive and appliance industries, farm equipment started out very slowly this year, picked up steam as fall came on, and now the outlook is for a long term business uptrend, rather than just a flurry. October marked a record month for many firms.

Shipbuilding today is more active than it has been at any time in the last 10 years, and backlogs now stand at nearly two years.

Construction equipment industry, spurred by the government's huge roadbuilding program, is showing a healthy upturn after a long period of waiting for orders to come through.

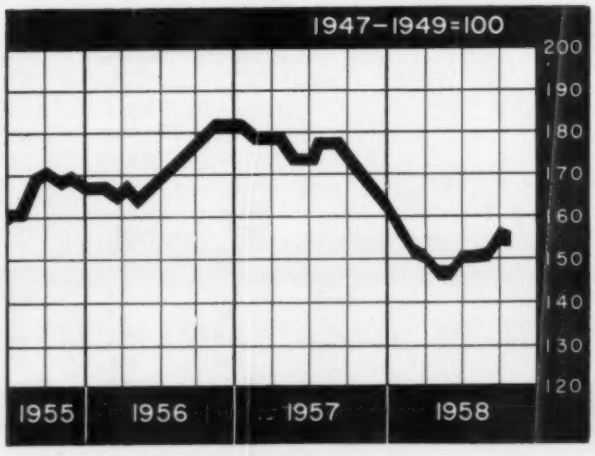
Electronics industry continues to thrive. Not only the major companies in the field are doing well, but small electronics subcontractors and job shops, too.

Among the basic and supplier industries for metalworking, latest reports show that:

- Sales of cutting tools have shown a sharp uptrend, coming from widely scattered sources.
- Contract heat-treating business is suddenly booming, except for HSS tools.
- Screw machine products makers report a sudden, sharp business increase in just the last week or two, after a long depressed period.
- New orders for industrial supplies and machinery, long an accurate gage of metalworking business conditions, have been increasing for something like six months.
- Sales of used machine tools, low for more than a year, have shown a sharp rise this fall.
- Gear manufacturing continues to show a steady 5%-or-so-a-month sales rise.

Steel production is still picking up fast. And while automakers are still cautious in their orders, other makers of durable goods are more than making up the gap. Customers are busily building up inventory and delivery times are being extended more and more.

Cold-rolled sheet and galvanized is reportedly sold out by the mills for the rest of the year, with structurals and plate less in demand and still available. Delivery on standard grades of wire is now about four weeks.



156

AMERICAN MACHINIST INDEX OF METALWORKING PRODUCTION

BASED ON MANHOURS WORKED IN THE FIVE COMPONENTS

	OCT. Estimated	SEPT. Preliminary	AUG. Revised	SEPT. Year Ago
Total Index	**156**	**155**	**156**	**174**
Machinery	**129**	**126**		**151**
Electrical Machinery	**184**	**188**		**207**
Autos	**67**	**76**		**94**
Other Transportation	**370**	**381**		**399**
Other Metalworking	**140**	**137**		**147**

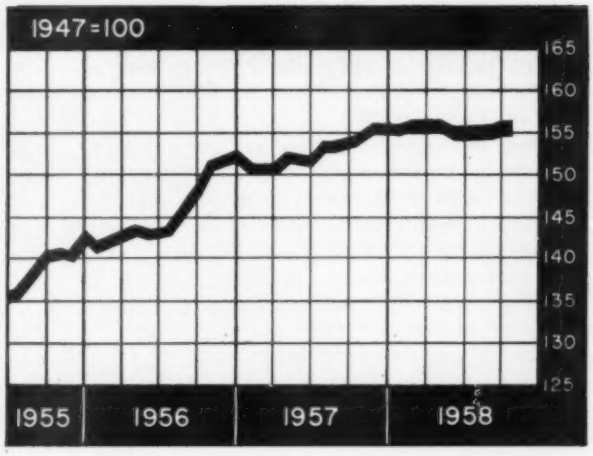
TRENDS

WHAT'S AHEAD... in Business

AMERICAN MACHINIST INDEX OF METALWORKING PRICES

	OCT Estimated	SEPT Preliminary	AUG Revised	SEPT Year Ago
Total Index	**155.8**	**155.8**	**155.8**	**153.9**
Metalworking Machinery	**180.7**	**180.8**	**180.4**	
Other Machinery exc Electrical	**166.2**	**165.9**	**163.9**	
Electrical Machinery	**159.1**	**159.1**	**157.0**	
Fabricated Metal Products	**146.1**	**146.2**	**144.5**	

155.8



From here, 1959 *really* looks good...

Business will be moving up fast in 1959. The McGraw-Hill preliminary survey of capital spending plans shows that companies have revised their plans upward since last spring. They now report a small increase scheduled for next year. And there is every likelihood of a larger increase as these companies complete their final budgets.

This type of an upturn, when added to the buildup of inventories that is now underway, promises to raise the total of private domestic investment substantially in 1959. When added to much higher expenditures by federal, state and local governments and higher consumer expenditures for nondurables and services, this revival of investment will assure an upward trend of business over the next 12 or 18 months.

There is one remaining development that could turn the improvement in business into a rip-roaring boom. That is a resurgence in consumer spending on durable goods: autos, appliances, TV and other expensive hardware. In consumer durables, more than in any other sector of the economy, there is the potential for a really spectacular rise.

A revival in consumer spending on durable goods would hasten the recovery of capital investment in the industries where present plans seem to be relatively low—iron and steel, nonferrous metals and autos.

The 1959 upswing isn't expected to move as fast or as far as the consumer durables goods boom of 1955, because there is no longer any carry-over of deferred demand from the World War II years or Korean War years. Some deferral of demand remained as recently as 1955.

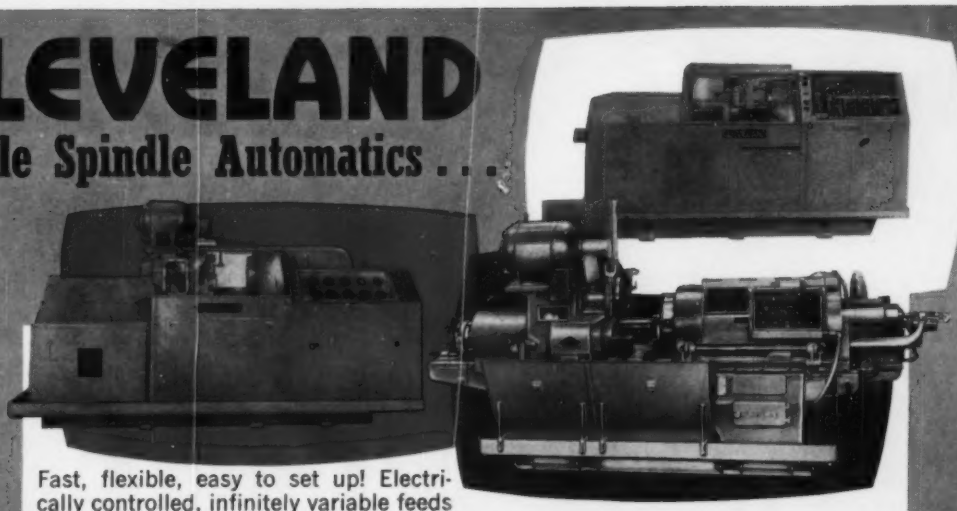
With the economic tides running so strongly in one direction, the outlook for business in the next year or 18 months is bright and is getting brighter all the time.

WEEKLY BUSINESS INDICATORS	Latest Week	Preceding Week	Year Ago
Business Week Index of Activity (1947-1949=100)*	136.0	136.1	141.7
Steel ingot production (thousand tons)	2,011	2,024	1,996
Electric power output (million Kilowatt hours)	12,330	12,174	11,860
Production of automobiles and trucks	127,339	90,410	154,894
Engineering construction awards (Eng. News-Record, millions)	$221.4	$272.9	$147.9

MONTHLY BUSINESS INDICATORS	Latest Month	Preceding Month	Year Ago
Refrigerators sales (thousands of units)	246	280	241
Vacuum cleaners sales (thousands of units)	280	264	241
Washers sales (thousands of units)	327	277	329
Household electric ranges sales (thousands of units)	48	56	59
Radio production (thousands of units)	929	622	966
Television production (thousands of units)	507	275	674
Gear sales index (1947-49=100)	N.A.	170.7	225.8
Foundry equipment new orders index (shipments, 1947-49=100)	N.A.	74.1	231.3

* Seasonally adjusted
N.A. Not available

CLEVELAND
Single Spindle Automatics . . .



MODEL AB
DIALMATICS
Capacities: 1⅜", 1⅝", 3", 4¼", 5¾".

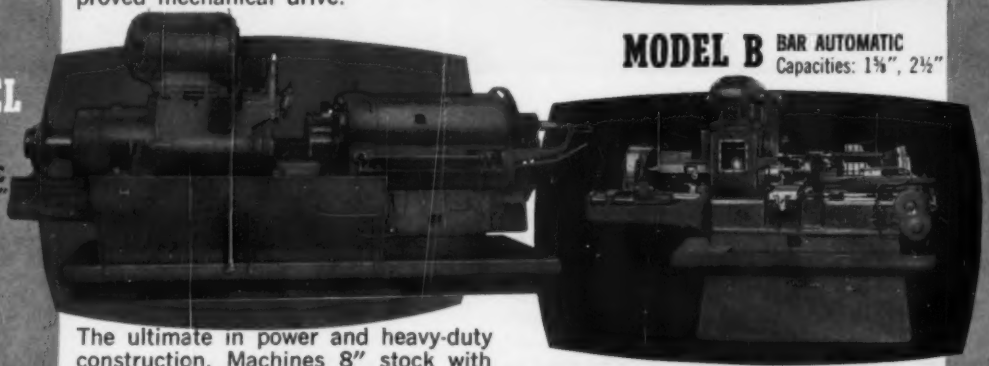
Fast, flexible, easy to set up! Electrically controlled, infinitely variable feeds are set by turning dials. On 1⅜" and 1⅝" sizes, turret feeds **and** spindle speeds are electrically controlled.

each a champion in cutting costs of your turning and forming work!

MODEL AW
AUTOMATICS
Capacities: 2½", 4¼", 5¾"

Simple, rugged, accurate! Differs from AB design in that variable turret tool feeds are obtained through an improved mechanical drive.

MODEL B BAR AUTOMATIC
Capacities: 1⅝", 2½"



MODEL A
AUTOMATIC
Capacity: 8"

The ultimate in power and heavy-duty construction. Machines 8" stock with ease and accuracy. Universal camming saves set-up time.

For detailed information on Cleveland Automatics call a Cleveland sales engineer or write for new General Bulletin.

Tooling is mounted on a flat milling slide and on two cross slides. Ideal for work involving multiple diameters, shoulders, etc. Model B-18" handles work to 18" long.

THE CLEVELAND AUTOMATIC MACHINE COMPANY

4928 Beech Street
Cincinnati 12, Ohio

SALES OFFICES: CHICAGO • CLEVELAND • DETROIT • HARTFORD • S. ORANGE

Manufacturers of a Complete Line of Single Spindle Automatic Screw Machines and High Pressure Hydraulic Die Casting Machines

LET IT RAIN!

With USS Galvanized Steel Sheets—**the zinc stays on**

Gutters must resist corrosion. The steel *must* have a uniform coat of corrosion-resistant zinc that will not flake off when the gutter is formed. That's why Klauer Mfg. Co. in Dubuque, Iowa, uses USS Galvanized Steel Sheets. The zinc sticks to these sheets. They can be folded double, *then unfolded*, and no zinc flakes off the base metal!

The result: a high-quality product, fully protected, for years of corrosion-free, maintenance-free life.

You can get the same results with USS Galvanized Steel Sheets. Call our local sales office or write to United States Steel Corporation, 525 William Penn Place, Pittsburgh 30, Pa.

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United States Steel Corporation—Pittsburgh
Columbia-Geneva Steel—San Francisco
Tennessee Coal & Iron—Fairfield, Alabama
American Steel & Wire—Cleveland
United States Steel Supply—Steel Service Centers
United States Steel Export Company

USS **United States Steel**

American Machinist

MAGAZINE OF METALWORKING PRODUCTION • ESTABLISHED 1877

What Are You Doing About It?

All of us have become accustomed to reading about new metalworking techniques and production processes to the point that we are inclined to forget some of the grubby and unpalatable aspects of our manufacturing plants.

AMERICAN MACHINIST'S 1958 Inventory of Metalworking Equipment, the first in five years and presented in 96 editorial pages in this issue, brings to light these grubby aspects. It documents with facts and figures the alarming growth of machine obsolescence in all segments of the metalworking industry.

Thanks to tremendous output . . .

during World War I, Metalworking started the postwar period with production equipment having the lowest average age in history. Only 38% of metal-cutting machines were 10 years old or older (10 years is the generally accepted dividing line between under-age and over-age equipment).

The situation has steadily deteriorated since then. Today, 3 out of 5 of metal-cutting machines installed in metalworking plants are over-age. And 64% of metal-forming machines are in the same class.

More than one million cutting-type machines are at least 10 years old. The bulk of them are of prewar design. One out of six is of 1935 or earlier design.

In production equipment . . .

other than machine tools—welding, heating, cleaning and plating—the story is the same. Obsolescence has got steadily worse through the years.

In over-age classification are 223,000 lathes, 215,000 grinders, 211,000 drilling machines, 108,000 milling machines. Tack on to that list 159,000 mechanical and 17,000 hydraulic presses.

The age of machine tools equals or exceeds the national average in ten out of sixteen industries. The percentage of machines at least ten years old has risen in 27 out of 29 major types of production equipment.

This sad showing comes at a time, mind you, when the Communist nations are turning out new machines of high efficiency at an unprecedented rate. Russia alone probably will build 150,000 or more machine tools this year.

The Inventory figures disclose a distressing indifference to modernization on the part of metalworking manufacturers. True, Metalworking momentarily is overbuilt in most of its segments. But it also is burdened with excessive production costs. How could it be otherwise when today's machines outproduce their counterparts of 1948 design by 54% on the average, yet a scant minimum of these new machines are now being installed by users.

What to do about it? . . .

Well, the first thing is for every metalworking manufacturer to take an inventory of his own equipment, machine by machine, if he has not already done so. Then measure the results against the industry average to see how he stands. He should compare the performance of his own machines, in actual cost per piece, with that of currently-designed machines. This may well be a revelation.

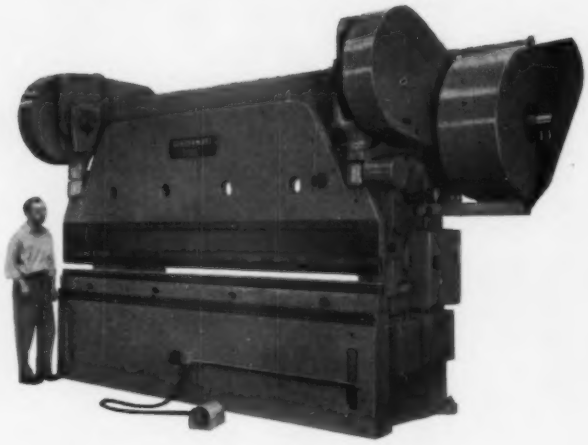
Comparisons, however, are not enough. What is needed is action, and plenty of it, to replace the old and inefficient with the new and efficient. Until such action is taken, Metalworking will continue to pay a high price for the inadequate and high cost productivity that it now is getting and will continue to get in the future.

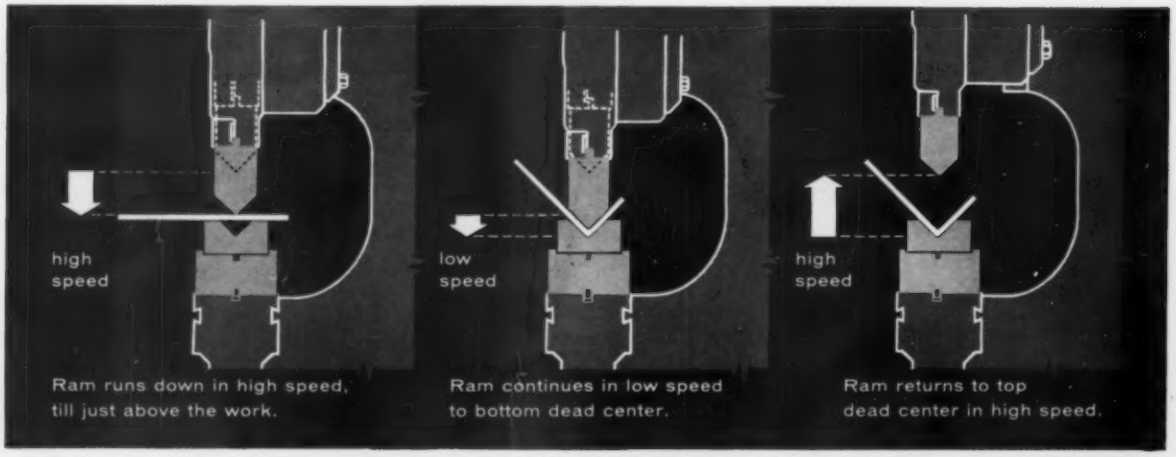
Burnham Finney EDITOR

10 to 60% increase in production makes

CINCINNATI® AUTOMATIC CYCLE

the most important press brake development in years!




high speed
low speed
high speed
Ram runs down in high speed, till just above the work.
Ram continues in low speed to bottom dead center.
Ram returns to top dead center in high speed.

Cincinnati® Automatic Cycle is a brand new feature which automatically provides two speeds to the ram for each stroke. It eliminates the "whip-up" of a sheet's free end that occurs when light gauge metal is formed over a small die opening at high speed.

Unlike previous attempts at reducing whip-up, the Automatic Cycle does not slow down the entire stroke of the press brake's ram. Nor does it require clutch slipping, which depends entirely on operator skill and at best is unreliable.

Think what these advantages can mean for you:

1. Actual job records show 10% to 60% increase in parts produced per hour.
2. You can set the length of the low-speed working portion of the ram stroke. Once this is set, all strokes are identical, which insures absolute consistency in the work.
3. Work spoilage (such as back bends caused by whip-up) is eliminated.
4. Highly experienced operators are not required.
5. Operator fatigue is greatly reduced by eliminating clutch slipping.
6. Clutch and brake are long-life, minimum-maintenance units requiring no adjustments.

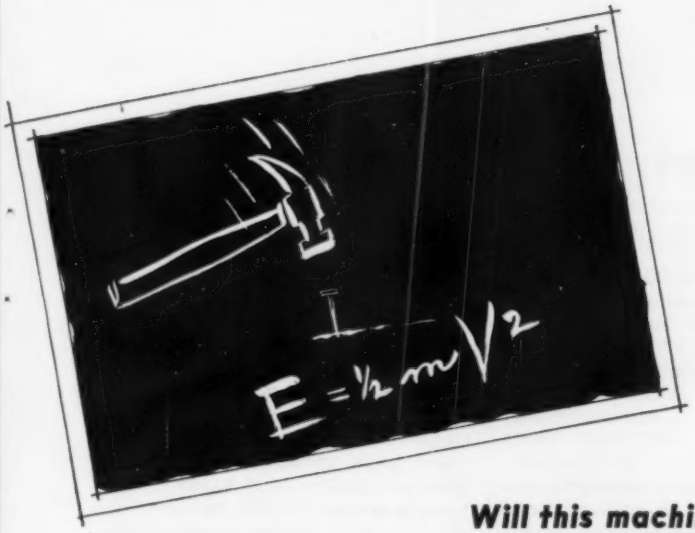
This productive new feature is available now on all 7 and 9 Series Cincinnati Press Brakes.

Write Dept. A for Bulletin B-9R, which gives full details about Cincinnati® Automatic Cycle.

Shapers / Shears / Press Brakes

THE CINCINNATI SHAPER CO.

Cincinnati 11, Ohio, U.S.A.



"Rate" has always been an important word in metalworking. Now it takes on added significance as concepts of *force* give way in the design of metal-forming equipment to *energy* delivered at rates approaching the speed of sound. Where E = ½ MV², emphasis is on *velocity*.

Will this machine that replaces force with energy to form metal in 1/1000 second mean a . . .

Revolution in metalforming?

"Given sufficient energy," says a relatively new theory of metal behavior, "metal will flow like a fluid—according to hydrodynamic principles." One way to apply this quantity of energy to a piece of metal is with a "shock wave," a load delivered at the speed of sound or higher.

During recent years, considerable research effort, with some production, has gone into "shock-working" metals. First reported in AMERICAN MACHINIST (*AM*—Oct 25 '54, p173), explosives have provided the most common power source.

Between shock-working and conventional pressworking, the major difference is the *speed* with which energy is delivered to the metal being worked. It is the difference between the boxer's "murderous left jab" and the slower, heavy pounding of a slugger.

According to Lockheed Aircraft Corp's Alfred H Petersen, a pioneer in high-energy-rate metal forming, explosives provide velocities of 4000 to 25,000 ft per sec. In air at sea level, sound travels slightly more than 1200 fps. A high-speed press might operate at 150 fps; most presses are considerably slower.

As another engineer put it, "The metal is moved before it knows what happened. It doesn't have time to fight back." Actually, it seems that the energy is poured into the work at a greater rate than the work can dissipate it, hence the metal's molecules are "jumping." During this brief period the metal has the characteristics of a viscous fluid.

Significant results with explosive energies include drawing, forming and extrusion of a variety of difficult-to-work metals such as titanium, Inconel, and a variety of tough stainless-steel alloys.

Improved physical properties in shock-formed parts, plus simpler die and equipment requirements, suggest applications of this technique for working conventional shop materials. For example, deep draws that call for four stages in a press might be done with a single shaped charge.

Two major drawbacks in this power source are the hazards of handling and using explosives in the plant and the lack of fine control. So far, some work is done outdoors for safety. In other setups operators use a long lanyard or electrical wire and duck behind a concrete wall during each shot—just in case!

Lack of control has resulted in some parts being incompletely formed while other shots destroyed the dies. Even with carefully measured charges, rate of burning varies, pressures vary from shot to shot and repeatability is seldom assured.

Recognizing these difficulties, engineers of the Dynapak Division of General Dynamics Corp's Convair Division sought a method of producing explosive energies without explosives (*AM*—Apr 23 '56, p124). Initially, their interest was in finding a safe and controllable high-energy source to shock test aircraft and missile structures. However, more than 2½ years ago they recognized the metalforming potential in this technique.

With a basic pneumatic principle (see page 239) taught to every beginner in physics—but obviously overlooked until now—these people developed an ingenious actuator. Using nitrogen gas at 2000 psi, the Dynapak 600 having a 6-in.-dia cylinder delivers 40,000 ft-lb of energy at better than 400 ft per sec. A 36-in.-dia model delivers 1,500,000 ft-lbs of energy.

While substantially below the velocities resulting from explosives, Dynapak nevertheless provides a rate of energy release which is more than adequate for hydrodynamic flow.

As described publicly for the first time by Chief Project Engineer John B Ottestad, the inventor, at the National Metal Exposition and Congress (Metal Show) in Cleveland during the week of Oct 27, all of this theory of hydrodynamic flow was worked out mathematically. The final size that should result was calculated for a number of different shapes using various masses and velocities. Then the actual pieces were made with the Dynapak machine and the results in physical measurements checked exactly with formula results.

When one-million psi was delivered, within 0.001 sec, into a closed die containing a piece of mild steel, something startling happened. Steel having an original yield strength of 40,000 psi came out of the die with a yield strength of 120,000 psi. Die

material was poor and two out of three dies were shattered. When the die held, the phenomenon of triple strength was apparent.

In another test, 2S-O soft aluminum was impact extruded with 1-million psi. The extruded strip "pinged" like spring steel and had similar elastic properties. Time, so far, has not been sufficient to determine whether these characteristics are permanent, whether they age out, or what other effects result.

In a private interview with *AM* editors, Lockheed's Al Petersen, who presented a paper on high-energy forming at the ASM meeting, was asked how he thought the Dynapak development would affect the field of explosive forming.

Mr Petersen thinks that Dynapak will be especially useful to the aircraft industry for producing ultra-thin titanium and steel structures as well as small impact extrusions of uneven cross-section. (It seems outstanding in producing thick sections with extremely thin fins.) He was also much impressed with the absence of decarburization.

Of particular significance is his opinion that Dynapak is more likely to increase the current interest and work in explosive forming than to obsolete it. Mr Petersen feels that Dynapak, and the principle it employs, is in a different field; that it is in a category of its own between conventional forming equipment and the use of actual explosives. He says that the biggest current application potential for explosive forming is in sheetmetal work and especially for bulging preformed shapes. (Dynapak forms sheetmetal through a water medium, too.)

Nevertheless, Mr Petersen readily acknowledged that the principles of Dynapak may affect explosive forming and forging developments now underway through Air Force developmental contracts. Still unfamiliar with all of the Dynapak details, as in fact are its inventors, he is planning to visit Convair very soon.

Other new developments

Very impressive at the show was the large number of ultrasonic machines. Most of this equipment was for cleaning but one firm (The Camman Mfg Co, Inc, Cleveland) showed a combination electrical-discharge and ultrasonic machine designed to cut metals and non-conductors at comparatively high rates of removal. Also, the ultrasonic system provides close tolerances. Unit is called Sparksonic SS-100.

Ultrasonic cleaning machines were exhibited by Phillips Mfg Co (Chicago); General Ultrasonics Div of Acoustica Associates (Hartford, Conn); Vibro-Ceramics Div of Gulton Industries (Metuchen, NJ); Curtiss-Wright Corp (Wood-Ridge, NJ); G S Blakeslee & Co (Chicago); Branson Ultrasonic Corp (Stamford, Conn); Narda Ultrasonics Corp (Westbury, LI, NY) and Detrex Chemical Industries, Inc (Detroit).

One of the more interesting systems shown was an automatic, conveyorized unit developed by Randall Mfg Co (New York City). It operates on a continuous, automatic load and unload cycle; requires about six to eight feet of floor space.

Glass "atmosphere"

An Italian process using molten glass as a furnace "atmosphere" for heating forging billets received considerable attention. Shown by Bal-Tate Furnace Co (Royal Oak, Mich), the rotary furnace is charged first with broken glass—the window variety is good enough—which is melted. Then the billets are introduced after preheating to 600 F. Molten glass adheres to the billets, protecting them from oxidation, scale, decarburization, and carburization. In the die, the glass acts as a lubricant. Based upon a different principle than the Sejourney process, it may also be used for extrusions.

Speaking of furnaces, a forced-convection heat-treating unit shown by Ipsen Industries, Inc (Rockford, Ill) circulates the heated atmosphere at 30 MPH in the heating zone. Blower is a fan capable of withstanding temperatures to 2000 F.

A built-in quench system forces oil from one chamber, through the work, and to a second chamber to provide positive flow through the work. Loads can be quenched with an oil flow of 4000 gpm.

Included with the unit was an automatic loader designed to "building-block" principles. These loaders are made in standard sizes to suit various requirements.

Metal-finishing equipment also received considerable attention. One of the more unusual machines was shown by Binks Mfg Co (Chicago). It included an electro-mechanical automatic spray-control for finishing non-repetitive, irregular patterns.

An eight-arm rotary spray unit with this automatic control permits running a mixture of irregular parts with no wasted paint or overspray. Machine starts to spray when any portion of the irregular shape reaches a predetermined position; each head shuts off at holes or breaks in the contour. Action is controlled by work touching a series of probes.

For manual spraying, Ransburg Electro-Coating Corp (Indianapolis) has come up with an ingenious electrostatic hand gun. As with its other electrostatic equipment, this gun, too, must be grounded to the work. However, in this unit a voltage pack is connected by flexible cable to the gun, creating an electrostatic field between the atomizing bell at the gun's muzzle and the work. Rotation of the bell feeds paint uniformly to its outer edge. Electrostatic attraction draws the paint to the work. No air pressure is used.

Tool and die outlook spotty for 1959

Contract tool and die shops in most major metalworking centers are being hit hard by reduced operations, dwindling backlogs, higher costs and serious price competition. And interest of metalworking in introducing new products today is so spotty that inquiries for tools, dies, molds and fixtures have dried up in some areas.

In other centers, there is moderate interest in tooling for radios, TV, electronics and auto parts, so that in a few cases an upturn in orders is anticipated. But for the industry as a whole, the prospects for several months to come are insufficient backlogs to permit efficient scheduling and use of labor, and a production level that may average 30% below last year's.

Geographically, this is the outlook:

Connecticut: business is already off 70% from last year, may get worse before it's better.

Newark-Philadelphia: business is 30% below last year, and price cutting is serious.

Cleveland: firms are operating at 70% of 1957 levels, but backlogs are down to four to six weeks.

Chicago is the nation's high spot, operating at 80% of 1957 levels. Orders for TV, radio, and electronics are coming up fast.

Los Angeles: operations stand at 70% of last year's levels. Changeover to missiles hasn't helped shops.

Capital spending starts its comeback

The many-months-long decline in capital spending by U S business in general and by the metalworking industry in particular will halt next year, and purchases of plant and equipment will begin a gradual climb back to pre-recession levels. That is the trend that can be read into results of McGraw-Hill Economics Department's just-released Fall Survey of Preliminary Plans for Capital Spending in 1959-60.

The years 1959 and 1960 will not mark rapid climbs back to the peak capital spending level of 1957. Rather, they will be years in which metalworking and industry generally will utilize present plant capacity to its fullest before launching extensive expansion and modernization programs.

Metalworking to Spend $3.3 Billion

Metalworking (comprising machinery, electrical machinery, automotive, transportation and "other metalworking" categories) will spend $3.3 billion in 1959, according to preliminary estimates—down only 0.6% from 1958. But spending will rise in 1960 to $3.4 billion.

Two things must be taken into account with these estimates: (1) the capital spending total for any given year is for machines delivered during that year—even if the machine was ordered the year before, and (2) such estimates tend to be conservative. Historically, preliminary plans tend to be revised upward as final budgets for a given year are completed.

Planned levels of metalworking spending are running somewhat ahead of the average for all manufacturing industries, which will be down 3% in 1959. But on the other hand, business as a whole (which includes metalworking and other manufacturing) expects to spend 2% more in 1959 than it did this year.

Thus nonmanufacturing industries will increase their expenditures for new plant and equipment in 1959 and 1960 more than will the manufacturing industries. Biggest increases are slated for the petroleum industry, commercial business, railroads and the "other transportation and communications" group.

Nevertheless, about half of all major U S manufacturing industries now plan to increase their capital spending next year, but no manufacturing industry plans to spend as much in 1959 or 1960 as it did in peak 1957.

Within the metalworking category, the automotive and automotive parts industry plans the greatest expansion in capital spending—$672 million in 1959 (up 4% from this year's $646 million) and $645 million in 1960. The machinery industries will increase their spending 1% in 1959 from 1958's $1 billion-plus, and plans for 1960 total $1.09 billion. The "other metalworking" category will also increase its spending 1% next year.

Aircraft Spending to Drop

Biggest decline in capital spending is expected in the transportation equipment group, which includes aircraft, ships and railroad equipment makers. This industry group's spending will fall off a drastic 13% in 1959 from this year's $408 million, but will pick up again slightly in 1960. Also on the capital spending debit side next year will be the electrical machinery industry, which will show an estimated 2% drop, then will recover in 1960 to a point approaching peak 1957 levels.

The primary metals industries are

U S business as a whole will spend more in 1959 on plant and equipment...

Industry	1957 (actual)	1958 (estimated)	1959 (planned)	1960 (planned)	1958-59 (% change)
Machinery	$1275	$1025	$1031	$1099	+ 1
Electrical machinery	599	517	507	583	− 2
Autos, trucks, parts	1058	646	672	645	+ 4
Transportation equip. (aircraft, ships, RR)	544	408	355	359	−13
Other metalworking	942	727	737	722	+ 1
ALL METALWORKING	4418	3323	3302	3408	− 0.6
Iron and steel	1844	1199	1043	1043	−13
Nonferrous metals	980	510	398	295	−22
Chemicals	1724	1400	1288	1211	− 8
Paper and pulp	811	602	566	634	− 6
Rubber	200	136	163	187	+20
Stone, clay, glass	572	404	447	461	+11
Petroleum refining	853	606	588	623	− 3
Food	627	570	612	598	+ 7
Beverages	223	167	201	202	+20
Textiles	408	264	229	273	−13
Misc. manufacturing	987	828	841	720	+ 2
ALL MANUFACTURING	13,647	10,009	9678	9655	− 3
ALL NONMANUFACTURING	24,790	22,843	23,344	23,006	+ 2
ALL BUSINESS	38,437	32,852	33,022	32,661	+ 0.5

...and sales are expected to rise sharply next year in most industries...

Industry	% change expected 1958-59
Machinery	8%
Electrical machinery	5
Autos, trucks, parts	20
Transportation equip. (aircraft, ships, RR)	2
Other metalworking	4
ALL METALWORKING	7
Chemicals	10
Paper & pulp	7
Rubber	11
Stone, clay, glass	11
Petroleum refining	4
Food, beverages	5
Textiles	8
Misc. Manufacturing	8
ALL MANUFACTURING	9

expected to retrench considerably in their outlays for new plant and equipment in the next two years. Iron and steel spending will drop off 13% in 1959, and nonferrous metals outlays will decline 22%. Iron and steel spending in 1960 will stay at 1959 levels, but nonferrous expenditures will show a further drop.

The survey indicates that those industries with the largest amounts of spare capacity today (primary metals and transportation equipment) are retrenching most over the next two years in spending plans.

Biggest surprise has been the automotive industry, which reduced capital spending by 39% this year, and now plans a 4% increase. Manufacturers' plans for capital spending in 1960 are already very close to 1959 totals—indicating that spending two years from now is almost certain to be higher than in 1959. The same is true of nonmanufacturing industries.

Manufacturing companies expect the current recovery in sales to continue into 1959, with next year's sales averaging 9% higher (7% is the estimate for metalworking industries). Those estimates apply to physical volume. The rise in dollar sales would be even greater if prices increase.

Thus with 1959 and 1960 already earmarked as turning points in the capital spending downswing, and with 1959 expected to be a year of general sales recovery, the year 1960 may see spending plans revised sharply upward.

Are outmoded tax laws industry's own fault?

American metalworking is going to lose more and more business to foreign competition abroad and in the United States itself unless something is done, and done fast, about this country's "unrealistic and shortsighted depreciation policy." That is the opinion of attorney Joel Barlow of Covington & Burling, Washington tax expert, speaking before the recent fall meeting of the American Machine Tool Distributors' Association in Boston.

U S businessmen still have to wait 15, 20 or 25 years to get back their investment in plant and equipment, Mr Barlow claims, while their competitors abroad, and even in Canada, can write off their investment in capital goods in less than 10 years, and sometimes in five years or less.

So handicapped, American manufacturers are bound to lose out to their comparatively unhindered foreign competitors, particularly the Russians, in world markets.

It's Not Only the Politicians

The politicians are only partly to blame for this situation, Mr Barlow claims—most of the onus falls upon manufacturers themselves for failing to understand the problems of depreciation, for failing to "take intelligent and foreful action" to get rid of Bulletin F, and for failing to avail themselves of the improved depreciation methods and allowances that have already been written into law.

In fact, Mr Barlow claims, the government has four times liberalized depreciation laws since the beginning of World War II—and four times the U S business community has failed to take full advantage of the new regulations.

Only 30% of U S manufacturers of metalworking equipment, who had raised a hue and cry about outmoded depreciation methods, availed themselves of accelerated depreciation (sum-of-the-digits and double-declining-balance methods) in 1954, the first year after it was enacted. The fact is, Attorney Barlow claims, that the politicians have been more receptive to change than business itself.

Chain Reaction Ahead?

In attacking the Treasury Department's controversial Bulletin F, which is being re-issued despite industry-wide antipathy toward it, Mr Barlow says that its continuance will foster a chain reaction:

(1) It means the continued use of more obsolete machinery and equipment, which means . . .

(2) Less productivity, which results in more . . .

(3) Inflation—and this means more deficits, more unbalanced budgets, continuing high tax rates, more demands from labor, more government controls, and in short . . .

(4) More of everything that is stifling to business enterprise and to the national health.

Reissuance of Bulletin F, however, is not the fault of the government but of U S businessmen, who were given more than a year to protest its continued use, but who were so indifferent in their response that the Internal Revenue Commissioner actually had to importune businessmen to file statements and comments on Bulletin F.

What can be done to prevent U S manufacturers from being left at the starting gate in the race for world markets? Industry itself, through the medium of its trade associations and the business press, must make an all-out effort, Mr Barlow says, to educate its "ignorant" (those who have been overstating their income and overpaying their taxes for years because they are "completely oblivious to tax and other fiscal realities"); its "misinformed" (those who rely on auditors or so-called tax experts who are afraid to admit that for years they have failed to take advantage of new depreciation laws); and the "selfish" (those manufacturers who are afraid to take realistic depreciation because this would substantially reduce the paper profits they have been relying upon for years to impress their bankers and their stockholders).

Handwriting on the Wall

One fact must be brought home to industry, Mr Barlow says, "The handwriting is on the wall for every industry that is losing out to obsolescence and inflation through inadequate depreciation writeoffs. Only through new and improved machines and equipment can any industry get out of the vicious circle which starts with inadequate depreciation. . . . Getting rid of the physical life concept of Bulletin F is the only hope of a modern national industrial plant."

Needed: industry re-education

If industry will do an effective job of first re-educating itself, then the people in Washington, "We will get a more enlightened depreciation policy very soon, and perhaps in time to save our markets. Then it would seem no one would have occasion at all to blame the politicians," he concluded.

NEW NMTBA PRESIDENT
Ralph J Kraut
President
Giddings & Lewis Machine Tool Co
Fond du Lac, Wis

FIRST VICE PRESIDENT
Alan C Mattison
President
Mattison Machine Works
Rockford, Ill

SECOND VICE PRESIDENT
Everett M Hicks
Vice president & general manager
Norton Co
Worcester, Mass

SECRETARY
Walter K Bailey
President
Warner & Swasey Co
Cleveland

Machine tool builders challenge the "20-minute nuclear war" concept . . .

Is our industrial buildup now geared to the wrong kind of war?

Washington's thinking is that the next war will be a 20-minute affair with nuclear weapons, that the making of rockets and missiles does not require large numbers of machine tools, and that the present state of the machine tool industry is nothing to worry about. Large quantities of machine tools will not be needed for national defense.

This point of view is very dangerous, Alfred V Bodine, president Bodine Corp and president National Machine Tool Builders' Association, told the members of NMTBA at their annual meeting at The Homestead, Hot Springs, Va, November 5-7. He asked "What assurance do we have that the next war, if any, will be a nuclear war?" He cited the thesis championed by Lt Gen James M Gavin that the United States may be in for a series of limited wars demanding special weapons, equipment and techniques.

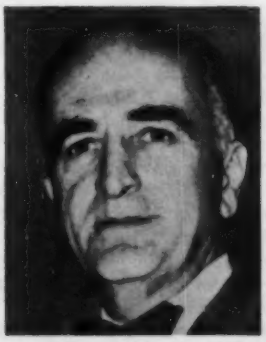
To be properly prepared, Mr Bodine contended, we should be ready to produce at a moment's notice "requisite quantities of weapons to be used in limited warfare." That sort of production requires a great many machine tools, so "for such emergency the country's machine tool capacity should be maintained at a high level."

"If machine tools are unimportant to military preparedness," Mr Bodine asked, "why are the Russians striving so feverishly to get their machine tool production up to 200,000 machine tools a year?"

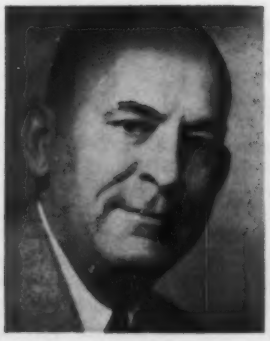
The government is doing nothing to stop the following practices, Mr Bodine pointed out: (1) increasing inroads of foreign competition upon the U S machine tool market; (2) Defense Department purchases of an increasingly large share of machine tools from foreign builders; (3) purchases in Europe instead of here of a high percentage of machine tools for the foreign aid program—(75% in 1958); and (4) slow writeoff provisions for capital goods insisted upon by Internal Revenue Service.

More and more U S builders, driven by economic necessity, are put-

TREASURER
Graham E Marx
President & general manager
G A Gray Co
Cincinnati



EXECUTIVE VICE PRESIDENT
Ludlow King
National Machine Tool Builders' Association
Cleveland



DIRECTOR
Grayson M Stickell
President & general manager
Landis Machine Co
Waynesboro, Pa

DIRECTOR
James K Fulks
Executive vice president
Ex-Cell-O Corp
Detroit

ting plants in Europe, thus transferring machine tool capacity to the other side of the Atlantic, Mr Bodine said. He suggested that a series of actions by the U S government might reverse this trend. He asked, "Is our industry, enmeshed in the web of reciprocal trade and low foreign wage rates, to go the way of bicycles and watches? Or is it, like shipbuilding and aircraft, to be regarded as a vital arm of national defense, and its capacity maintained accordingly?"

Mr Bodine praised the Governmental Interagency Committee in Washington for its excellent job in channeling surplus general-purpose machine tools, in good condition, into the National Industrial Equipment Reserve and for placing other surplus machines in schools and colleges for training.

Fewer government machine tools will be disposed of by public sale in calendar years 1958 and 1959 than in many years, despite the fact that three times as many machines will be declared in excess, John H Williams, chief, Production Equipment Branch, Office of Assistant Secretary of Defense, stated. Most of the machines will go into the national equipment reserve and schools.

Mr Williams described the problem of setting up the Defense Department's machine tool replacement program, and predicted that not all of the $41 million now allocated for fiscal '59 will be spent. The Navy however has not only put in "justifications" for its $20 million allotment to be bought but also has submitted evidence to support replacement of another $10 million specially assigned to the Navy by the Defense Department.

If the procurement officers of the armed services are to buy American machine tools instead of foreign, Mr Williams said that the executive order from the White House must be changed so that ordering of foreign machines is not compulsory if a certain price differential shows up in the bidding. He brought out the fact that half of the government's holdings of machine tools (around 275,000 units) date from World War II or earlier.

Some 96,000 machine tools and 13,000 items of related production equipment will be required for the "Tools for Schools" program, Niels A Olsen, director, Metalworking Equipment Division, Business & Defense Services Administration, said.

Methods have been developed for insuring an effective flow of surplus machines to schools, but recently, before the methods got working, some tools in the Middle West were disposed of at public sale. Action has been taken to see that this does not happen again. BDSA is reviewing all scheduled contracts in the M-Day machine tool "trigger" program to insure that they reflect both current mobilization needs and the industry's technical growth and progress, Mr Olsen revealed.

The long lead time and critical machine tool studies are still waiting on current mobilization requirements from the Defense Department, but data are expected shortly.

It's Tool "Exposition" Now

Plans for the 1960 Machine Tool Exposition (the word "show" has been abandoned) were outlined by William E Rutz, executive vice president, Giddings & Lewis Machine Tool Co. He said that 75% of NMTBA members, in response to a survey, voted to hold in the main to the basic policies of previous expositions and to the whole concept on which expositions have been held. As in 1955, the exposition is scheduled for Chicago in the same (only expanded) facilities.

The 1960 exposition dates September 6 through 16. NMTBA has a commitment for rental of these facilities for expositions in 1965 and 1970 as well as in 1960. Mr Rutz announced that Donald H McIver, vice president Ex-Cell-O Corp, is taking over as chairman of the 1960 Exposition Committee. He suggested that the slogan of the 1960 exposition might well be "reducing production cost." He stressed the fact that while users have been trying to extract profits from operation of obsolete machines, "We are coming up with ways and means whereby they can regain their profits through increased productivity."

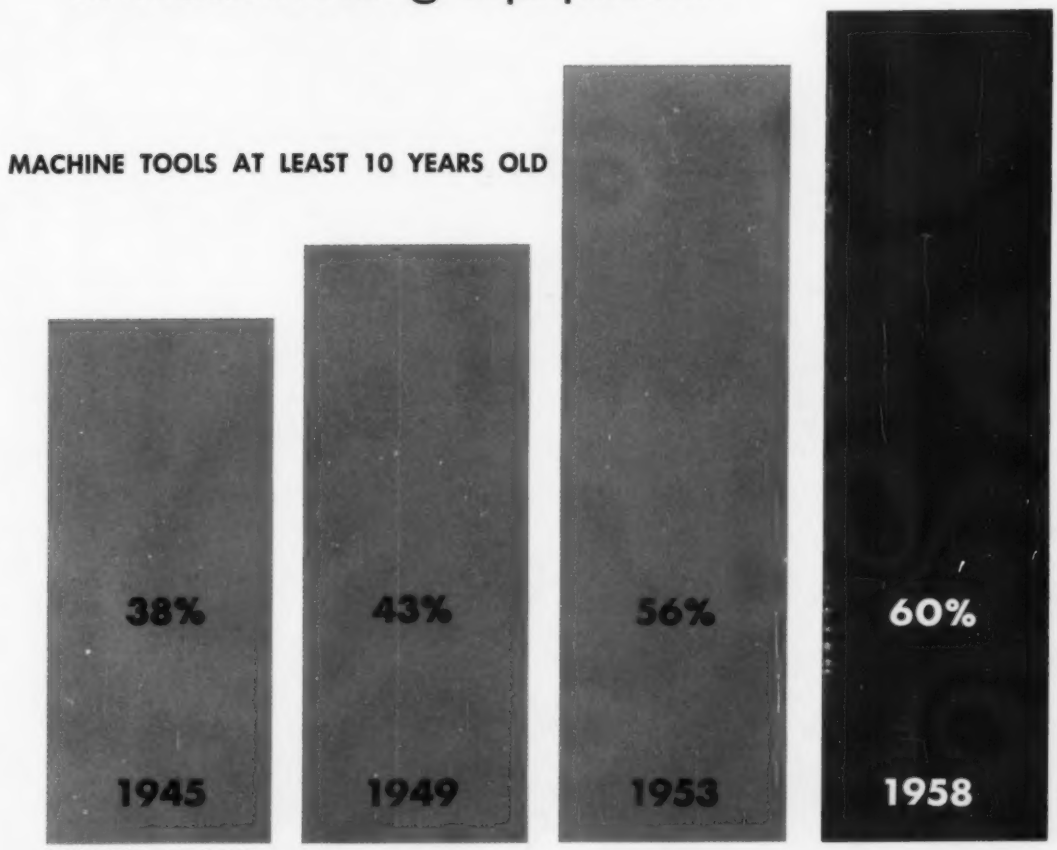
A number of areas where machine tool builders could have done a better job in supplying their machines were described in a paper by A P Higgins, manager military relations, Convair Division of General Dynamics Corp, San Diego—read in his absence by Fred F McLaughlin, factory manager of Convair plant No. 2.

- Builders have had a tendency to regard their jobs as done when machines were loaded in boxcars at the factory.
- Builders' field representatives were not experienced enough on the particular machine to be serviced.
- Lack of quality control was obvious when machines went into production.
- No effort was made, in many cases, to assist the purchaser in preparing his factory to receive the machines.
- In a majority of cases, set-up drawings were not available when needed and were obtained only by constant follow-up.
- There was too much damage to machines in transit due to improper preparation for shipment.
- There is a tendency by builders to oversell without backup.
- Too much laxity by builders in furnishing maintenance instructions, manuals and advice.
- There has been a tendency for builders to ignore requirements often inherent in engineering sales manufacturing, because such developments cost a lot of money. The result is that users have been responsible for establishment of new machine tool companies. Example: 11 press makers were asked to bid on a high-pressure, rubber-forming machine. Eight of the 11 declined to bid and tried instead to sell their existing products. Of the three that bid, the one awarded the contract built an excellent press.
- Builders have provided no solution to existing problems about machine tools, such as chip disposal, thus preventing using maximum capabilities of machines.
- Builders often have not acted as prime contractors, as they should, when a machine tool has components from several sources.
- While the machine tool industry did an excellent job on the large press program, it did a poor job in supporting the machining requirements for these large forgings.

Mr Higgins acknowledged that it was just plain good business practice for builders to take care of high-volume customers, such as automakers, who were back in the market every two years or so and that developing special tools for the aircraft and missiles industry was not too lucrative because of high, single-pass costs in engineering and tooling. He said though that his own industry was driven then to develop its own specialized equipment, such as spar milling, high-pressure rubber forming, bonding and brazing. He made a plea for a joint solution of the problem coming up in working steel and titanium by the machine tool and the aircraft industries.

The following 96 pages, numbered Inv-1 to Inv-96, constitute pages 129 to 224 inclusive of this issue.

The Eighth American Machinist Inventory of Metalworking Equipment



SOURCE: American Machinist

3 out of 5 Machine Tools Are Over-age

• More machine tools are over-age (more than 10 years old) than at any time since the depression days of the 1930's: 60% of metal-cutting machines and 62% of metal-forming machines.

• The total number of machines installed in the metalworking industries has declined since 1953, reversing a trend that had continued uninterrupted since before World War II. During this same period, capacity increased 40%.

These facts emerge as the major conclusions from the mass of data contained in the new AMERICAN MACHINIST Inventory of Metalworking Equipment.

More than a million metal-cutting machines are over 10 years old. A few thousand of these were installed after the introduction of post-war models in 1947. The bulk of them are of 1939 design. More than a quarter million of these—nearly one of every six machines installed in Metalworking—are of 1935 design or earlier.

Of the metal-forming machines, 313,000 are more than 10 years old and 117,000 have seen better than 20 years of service.

There is a sharper increase in the percentage of old welding equipment than there is in machine tools, despite an im-

Grand Summary

This table summarizes reports from 16 industry tables and 24 geographic tables that appear on pages 21 through 60. According to the 1958 McGraw-Hill Census of Manufacturing Plants, there are 24,872 metalworking plants with 20 or more workers, employing 6,736,000 wage earners.

	Total Units	10 yrs & over	Over 20 yrs
METAL CUTTING	1,706,984	60%	16%
METAL FORMING	510,758	62	23
OTHER EQUIPMENT	626,947	45	7
TOTAL	2,844,689	57	15

* – Less than 10

	TOTAL	10-20 YEARS	OVER 20 YR
METAL-CUTTING MACHINES	1,706,984	742,371	276,199
Boring Machines	62,627	25,487	11,036
Horizontal boring, drilling, & milling	20,376	8,757	3,970
Vertical boring mills incl vert turret lathes	18,002	7,939	5,221
Precision, horizontal and vertical	13,082	4,908	729
Jig boring, horizontal and vertical	8,889	3,064	656
Other (except boring lathes)	2,278	819	460
Broaching Machines	12,498	5,254	2,168
Horizontal internal or combination	4,574	2,146	1,093
Horizontal surface	1,261	485	216
Vertical internal	2,786	1,086	432
Vertical surface or combination	2,891	1,204	302
Continuous horizontal & vertical	215	32	22
Other (incl rotary surface)	771	301	103
Contour Sawing and Filing	17,476	7,406	1,117
Cutoff Machines	94,930	39,432	8,976
Bandsaw (incl friction)	37,279	15,212	2,557
Abrasive disk	13,692	5,283	710
Hacksaws	27,511	13,247	3,847
Circular (incl friction)	11,963	4,251	1,305
Other	4,485	1,439	557
Drilling Machines	357,789	155,133	56,312
Sensitive	64,467	29,229	10,292
Upright: Single-spindle	166,399	72,219	24,558
Gang	39,079	17,649	5,752
Radial	39,411	18,030	7,800
Multi-spindle cluster, adjustable and fixed center	18,558	7,535	3,248
Automatic	5,246	1,357	351
Unit head & way type (not dial)	4,331	1,429	610
Deep-hole drills	2,482	905	572
Other (not incl special machines)	17,816	6,780	3,129
Gear Cutting and Finishing Machines	42,230	17,743	9,311
Hobbing machines, gear	16,841	7,191	3,903
Shapers, gear	9,492	4,786	1,686
Form-milling type (spur and bevel)	2,397	701	1,345
Bevel-gear cutters (not planer)	4,769	1,761	1,043
Grinders, gear tooth	2,087	1,006	197
Shavers, gear tooth	2,520	1,008	182
Burnishing and lapping	1,637	490	305
Chamfering, tooth pointing, tooth rounding	1,261	447	249
Other	1,226	353	401
Grinding Machines	360,566	164,299	51,419
External cylindrical: Plain	28,574	14,478	4,924
Universal	12,049	5,642	1,497
Internal cylindrical	14,732	7,385	1,933
Centerless: External	12,200	5,716	1,086
Internal	2,484	1,126	397
Surface: Rotary-table type	17,178	7,543	2,349
Reciprocating type	41,611	18,749	4,658
Disk, horizontal and vertical	13,684	5,858	2,356
Tool and cutter (incl drill)	67,282	29,443	11,624
Bench, floorstand, and snag	103,632	51,773	14,854
Jig grinders	1,957	709	132
Contour grinders	3,592	1,523	213
Abrasive belt (not polishing)	21,717	8,090	881
Other (except thread grinders)	19,874	6,264	4,515
Honing and Lapping	20,764	7,860	1,490
Honing: Internal (incl combination)	10,318	3,786	430
External and surface	1,048	373	28
Lapping: Surface	4,780	1,916	467
Cylindrical	2,645	1,015	346
Other (incl combination hone-lap)	1,973	770	219
Lathes	349,068	158,655	64,503
Bench, floor, ft-dy (incl turret attachment)	57,577	25,944	9,256
Engine, heavy-duty: Standard	73,107	32,257	20,754
Toolroom	39,382	17,333	5,842
Manufacturing and gap	6,897	2,657	1,808
Tracer	3,681	613	100
Turret lathes: Ram type	47,665	25,325	6,037
Saddle type	26,739	14,942	3,828
Auto chucking & between centers (single spindle)	14,819	5,994	2,531
Automatic chucking (multi-spindle)	8,546	3,349	1,377
Automatic screw machines (single spindle)	43,224	18,011	8,090
Automatic bar machines (multi-spindle)	18,280	9,154	2,081
Other (except spinning lathes)	9,151	3,076	2,799
Milling Machines	176,684	77,132	31,152
Bench type	7,892	3,344	1,161
Hand	19,668	9,510	4,549
Knee-type: Horizontal (plain & universal)	61,458	28,463	12,837
Vertical	36,130	14,628	3,005
Automatic & manufacturing	11,549	6,073	1,779
Ram type, swivel head	5,734	1,668	270
Bed (Lincoln) type, incl automatic rise and fall	9,639	4,657	1,836
Planer type (incl skin and spar)	3,461	1,349	1,044
Profilers, duplicators, diesinkers, engravers	12,033	4,511	1,633
Other (except thread milling)	9,120	2,929	3,038
Planers	12,279	4,289	6,111
Double housing	8,160	2,841	4,521
Openside and other	4,119	1,448	1,590
Pipe Cutting and Threading Machines	14,651	5,903	2,039
Polishing and Buffing Machines	82,731	34,551	9,159
Polishing stands (bench and floor)	40,640	17,069	4,580
Speed lathes	13,765	6,533	2,547
Abrasive-belt, disk, drum	20,727	8,235	1,260
Other	7,599	2,714	772
Shapers	35,770	15,922	11,447
Horizontal	29,227	13,066	9,383
Vertical, incl slotters & keyseaters	6,543	2,856	2,064
Threading (except pipe)	43,205	19,187	7,781
Tapping	19,844	8,568	2,700
Hobbing and milling	4,685	2,503	1,030
Die type	4,873	1,996	1,428
Grinders, thread	4,650	3,054	257
Rolling machines, thread	5,585	1,693	1,515
Other	3,568	1,373	851

	TOTAL	10-20 YEARS	OVER 20 YR
Electro-Erosion Machines (exc Tap disintegrators)	578	77	*
Ultrasonic Cutting Machines	178	18	*
Special Multi-Station Machines	16,258	1,798	644
In-line and transfer	8,596	207	58
Dial or rotary table	3,819	778	421
Automatic assembly (all types)	3,843	813	165
Other Metal-Cutting Machines	6,702	2,225	1,534
METAL-FORMING MACHINES	510,758	196,587	117,258
Bending and Forming Machines (Power)	65,372	25,282	10,028
Bending rolls, sheet and plate	17,970	7,402	3,971
Bending rolls, bars and shapes	4,537	1,951	837
Bending brakes	28,255	10,888	3,519
Rotary bending and forming machines	4,811	1,585	683
Bending machines, pipe, bar, and shapes	9,799	3,456	1,018
Wire and Strip Forming Machines	16,815	5,644	4,004
Hydraulic Presses	33,179	12,646	4,744
Vertical, single-action	22,950	8,820	3,048
Vertical, double and triple action	3,580	1,413	550
Horizontal	3,152	1,214	743
Extrusion (from hot billets)	452	128	82
Other (incl stretch and hydro-pneumatic)	3,045	1,071	321
Pneumatic Presses (except hydro-pneumatic)	6,991	2,775	374
Mechanical Presses (Power)	240,583	92,338	67,119
Inclinable, single-action (incl inclined)	123,394	51,583	29,107
Vertical, single-action: Straight-side (incl arch)	41,383	14,534	14,659
Vertical, single-action: Gap or C-frame	35,312	12,137	11,128
Vertical, single-action: Adjust. bed and homing	10,330	4,044	3,285
Double and triple action	5,466	1,989	1,529
Dieing machines	2,090	627	329
Horizontal (incl bulldozers)	2,205	743	901
Multiple transfer (incl eyeletting)	3,569	1,697	616
Other	16,834	4,984	5,565
Punching and Shearing Machines	69,705	27,687	16,401
Punching machines (incl turret)	19,072	6,865	5,236
Plate and sheet shears	26,311	10,922	5,173
Bar and angle shears	7,359	2,895	2,103
Rotary shears, incl slitters	6,503	2,625	1,960
Nibbling machines	6,066	2,574	777
Other	4,394	1,806	1,152
Forging Machinery (except presses)	20,302	7,932	8,247
Hammers, steam or air	3,934	1,448	1,833
Hammers, mechanical (incl drop and helve)	5,708	1,990	3,046
Forging machines (headers) and rolls	6,079	2,517	2,016
Swaging machines	3,382	1,700	1,017
Other	1,199	277	335
Riveting Machines (not portable)	46,195	18,290	5,714
Squeeze type	21,621	8,661	1,920
Rotary-vibrating type	5,930	2,034	1,081
Spinning type	5,243	2,661	971
Hammer type	13,401	4,934	1,742
Die Casting Machines	3,446	895	149
Hot chamber	2,563	712	113
Cold chamber	883	183	36
Plastics Molding Machines	8,170	3,098	478
Injection	2,006	535	67
Compression	5,946	2,477	411
Extrusion	218	86	*
WELDING EQUIPMENT	299,711	120,945	15,393
Electric Welding Equipment	283,594	113,762	14,720
Power source: Motor-generator set	94,312	50,128	5,467
Transformer and rectifier	83,159	23,748	1,313
Arc-weld machines (not hand) incl automatic	26,713	10,298	810
Resistance welders: Spot	65,071	24,639	5,776
Gun (not hand)	5,581	1,673	307
Seam	3,132	1,368	197
Butt and flash	5,626	2,178	850
Gas Welding Machines (not hand)	3,357	1,216	131
Flame Cutting Machines (not hand)	12,760	5,967	542
HEATING EQUIPMENT	99,024	39,148	12,318
Heat-treating furnaces	42,592	19,524	6,391
Atmosphere generators	3,657	1,025	334
Stock-heating furnaces	11,879	4,601	2,508
Salt baths	8,664	3,889	851
Induction heating units	7,944	1,948	159
Baking and drying ovens	22,382	7,468	1,876
Flame-hardening units	1,906	693	199
CLEANING AND FINISHING	80,985	29,257	8,953
Cleaning Equipment	65,110	23,091	8,030
Barrel finishing machines	26,704	9,163	5,697
Shot and abrasive blast	12,417	5,182	929
Parts washing machines (incl degreasers)	24,135	7,985	1,274
Pickling machines	1,854	761	130
Plating Equipment	15,875	6,166	923
Machines	7,616	2,474	498
Barrels	8,259	3,692	425
INDUSTRIAL TRUCKS (Power-Driven)	82,895	24,784	3,383
Lift (rider-type)	46,212	13,766	1,526
Truck-tractor	9,412	2,158	330
Powered hand trucks	22,618	7,146	1,133
Crane trucks	4,653	1,714	394
OTHER SHOP EQUIPMENT	64,332	24,683	5,623
Balancing Machines	7,624	2,571	684
Air Compressors	49,959	19,758	4,184
Gear-Checking Machines	6,749	2,354	755

pressive increase in the amount of welding equipment in use. The portion over 10 years old has risen from 39 to 46%.

Similar increases have occurred in heating equipment, cleaning and plating machines, industrial trucks, and other shop equipment. In fact, there is no single class of production equipment in which the percentage of 10 year old models has not increased since the 1953 Inventory.

Total Equipment Declines

Most striking single fact is the decline in total machine tools. **Two factors are responsible for this decrease. First is the increasing use of multi-station machines.** The trend to these machines has resulted in their inclusion in this Inventory for the first time. Each of these machines has anywhere from two to more than a hundred stations.

About half of the 16,000 multi-station machines are installed in the auto industry, and this industry shows the sharpest decline in the total number of machine tools —from 220,000 in 1953 to 164,000 in 1958.

The second factor contributing to the decrease in total machines is the continuing decline in the machines more than 20 years old. From 21% of metal-cutting machine tools that were in this oldest age group in 1949, there was a decline to 19% in 1953, and to 16% today.

Metal-forming machines have always tended to have a higher average age than metal-cutting machines, but the same decline in equipment more than 20 years old is taking place: From 28% in 1949, to 25% in 1953, to 23% in 1958.

A recent AMERICAN MACHINIST study of productivity of machine tools found that today's machines are 54% more productive, on the average, than those of 10 years ago. A similar study in 1950 showed a 40% improvement over 1940 models. From these studies it is evident that the machines of 1938 vintage disposed of have been replaced with a much smaller number of new machines capable of doing more work.

Because the million old machines still installed are nearly all of 1939 design, they represent much the same chance for replacement of several old machines with one new one. Thus, if the metalworking industries make any substantial replacement of these 10-year-old machines, the decline in the total number of machine tools will continue.

A study of the tables in these pages thus becomes a study in contrasts: On the one hand we have the picture of a continuing increase in the average age of equipment. On the other hand we have some companies and some industries doing such an effective job of modernization that the total amount of equipment declines while the capacity rises.

In the 44 industry divisions in which the tabulations were made, there is a range from 38% to 82% in the proportion of over-age equipment. This wide variation is in a real sense a measure of the average extent to which each industry is taking advantage of the cost-cutting possibilities of new equipment.

What You Should Do

An unparalleled opportunity to measure your productivity against your competitor's is provided by this Inventory. There may be as much variation between you and your competitors as there is from one of the 44 industry groups to another. You can make a quick check by calculating the percentage of machines over 10 years old in your plant and comparing it with the 44-industry chart on page 8.

Detailed tables are published of equipment combined into 16 industry groups. You can make a more detailed comparison of your condition by comparing each type of machine with the same type in your industry group. These tables will be found on pages 21 through 36.

If you find that your equipment is older than the average for your industry, you will have the strongest possible evidence to convince your management of the urgent need for an immediate modernization program.

Space limitations make it impossible to publish here the complete details on each

HIGHLIGHTS OF THE EIGHTH INVENTORY

• MACHINE AGE UP — 60% of the nation's machine tools (metal-cutting and metal-forming types) are at least 10 years old. This is a 4% increase since the last Inventory in 1953. 18% of machine tools are over 20 years old.

• MACHINE TOTALS DOWN — The number of machine tools in Metalworking has decreased since the last Inventory. Here is the first tangible proof that automation has affected the quantity of machines in the country.

• INDUSTRY RECORDS SPOTTY — Machine age in ten of the sixteen industries covered exceeds the national average of 60% at least 10 years old. A few industries have excellent modernization records, but equipment in the bulk of Metalworking industries has a high degree of obsolescence.

• SOUTH AND WEST GROWING — In fifteen of the twenty-four areas reported, machine-tool age equals or exceeds the 60% national average that is at least 10 years old. The bulk of machine tools are still in the Midwest and Northeast, but in other sections of the country Metalworking is expanding.

• BIGGEST RETURN — Plants employing 40% of the wage earners in Metalworking sent in reports upon which this Inventory is based — by far the biggest return in any survey of its kind ever published.

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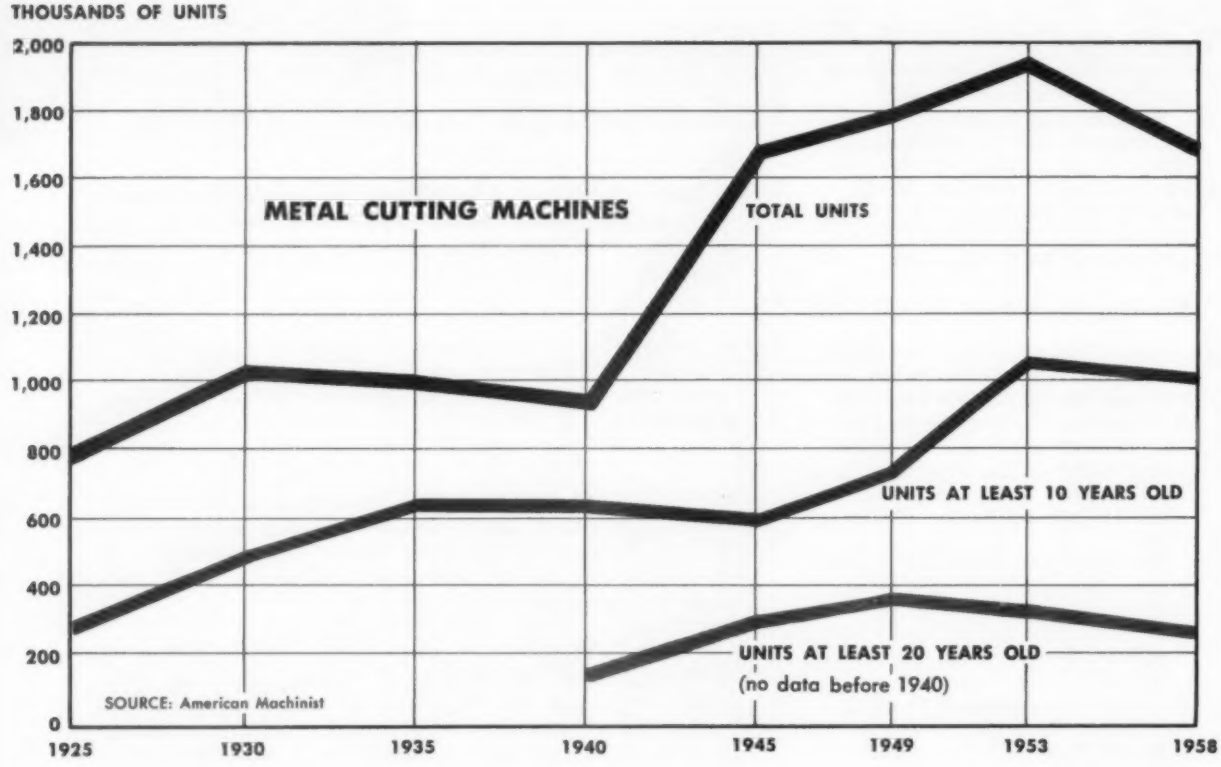


of the 44 industries that are combined into the 16 industry tables. Detailed tables for each of the 44 industries are available in the editorial offices of AMERICAN MACHINIST and the editors will be glad to answer questions about them to the extent that it is possible to do so. No questions can be answered that would involve disclosure of information about individual plants.

Over-Age Machines Widely Distributed

Machinery at least 10 years old is not confined to a few industries or a few areas, but is widely distributed throughout all of Metalworking.

In ten of the sixteen industries reported in the Inventory, machine-tool age equals or exceeds the Metalworking average of 60% at least 10 years old. These ten industries have 70% of the nation's machine tools of all ages.

On the other hand, modernization has been fairly extensive in all or part of the six industries in which machine age is below the national average. Outstanding here are the Communications Equipment industry and the Automotive and Aircraft industries, where modernization has been most necessary in recent years. In equipment other than machine tools—welding, heating, and cleaning and finishing equipment, as well as industrial trucks—these industries are well ahead of the Metalworking average.

A more detailed analysis of the sixteen industries appears on pages 6-10.

Distribution of machine tools by geographical area is similar to that for industries: **Obsolete machinery, lots of it, can be found in every area. In fifteen of the twenty-four areas in the Inventory, the percentage of machines at least 10 years old equals or exceeds the national average of 60%.**

Study of the area tables shows that the bulk of machine tools still are in the traditional centers of Metalworking—the Midwest and the Northeast. Since 1953, however, substantial percentage gains in the South (especially the Richmond area) and continued growth in the Los Angeles area have produced interesting, if slight, shifts in machine-tool concentration. Percentage of total US machine tools is down in the East and up in every other section of the country. The largest concentration of machines per 1,000 population, however, still is in the Bridgeport–Hartford area, as in 1953. And this area, along with the Boston area, still has the greatest number of machines per 100 employees.

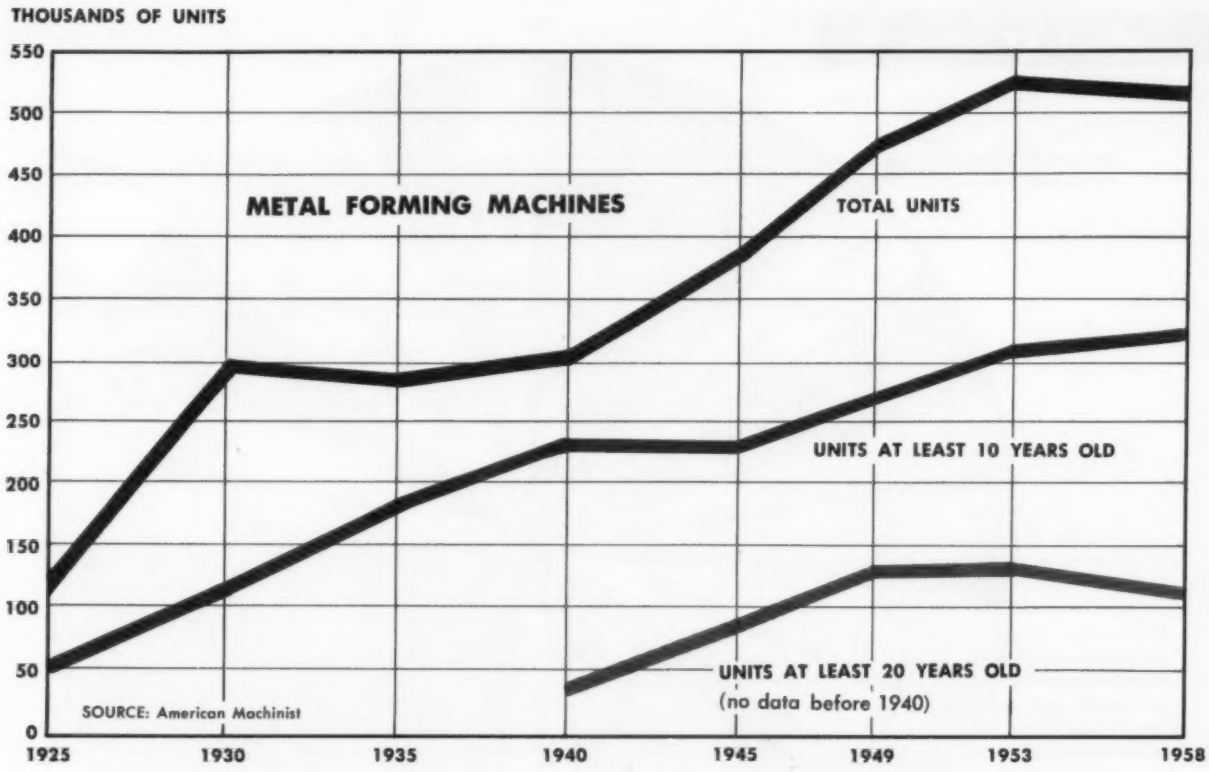
A more detailed analysis of geographic areas and the equipment in them appears on pages 16-19.

The 10-Year Yardstick

The 10-year age as a general yardstick for obsolescence was adopted by AMERICAN MACHINIST in 1925 when the first Inventory was taken. A uniform standard of some kind was essential—one that could be applied to all types of equipment and to the various industries and areas. It is recognized that some machines over 10 years old are still quite useful and should not be replaced merely because of their age. On the other hand, much of the equipment less than 10 years old is obsolete because newer, more efficient units have been developed to do the same work.

This 10-year yardstick has now achieved a wide acceptance as the best available measure and the term "over-age," widely used in industry, has come to mean machines that are more than 10 years old.

Special meaning has been given to the 10-year yardstick at this time because of the special study of the gain in machine productivity, 1948 to 1958, recently completed. This study found that the average 1958 machine is 54% more productive than its 1948 counterpart. (The complete details of this study are in "The Technological Compulsion to Modernize," *AM*—Oct. 20 '58, p151.)



Standards become even more meaningful when they are applied repeatedly. The 10-year yardstick, applied consistently since 1925, and shown clearly in the charts on these pages, points clearly to the trends in machine-tool distribution. This trend has been one of steady increase in the percentage of over-age machines since the end of World War II.

Data on machines more than 20 years old, first gathered in the 1949 Inventory, has again been included. Here, again, an occasional machine may be retained for operations performed so infrequently that replacement is not justified. But certainly very few of these ancient machines can be efficiently integrated into a modern production operation.

Despite the limited progress that has been made in reducing the amount of equipment in the over 20 age group, the facts are that 277,000 metal-cutting machine tools were built before 1938, and that 117,000 metal-forming machines date from the same period. These represent nearly one out of every five machines with which the nation enters the space age.

Source of the Data

The Eighth AMERICAN MACHINIST Inventory, like its predecessors, is a projection based on a very large sample. Specifically, it is based on detailed confidential reports received from 5560 plants employing 40% of the wage earners in Metalworking.

This represents a sharp increase from the 3900 plants employing 29% of the workers on which the Seventh (1953) Inventory was based. This increase is the best possible indication that Industry has increasingly recognized the value of this Inventory.

The complexity of the Inventory questionnaire has previously defeated attempts to handle the tabulation by machine. This time, the size of the project made such a method imperative, and persistent efforts developed a programming technique that made it possible to transfer the data to punched cards.

Adoption of programmed tabulation made possible refinements in the projection techniques. A total of 1056 expansion factors were calculated, checked, and applied to the data. Further explanation of the statistical method will be found on page 20.

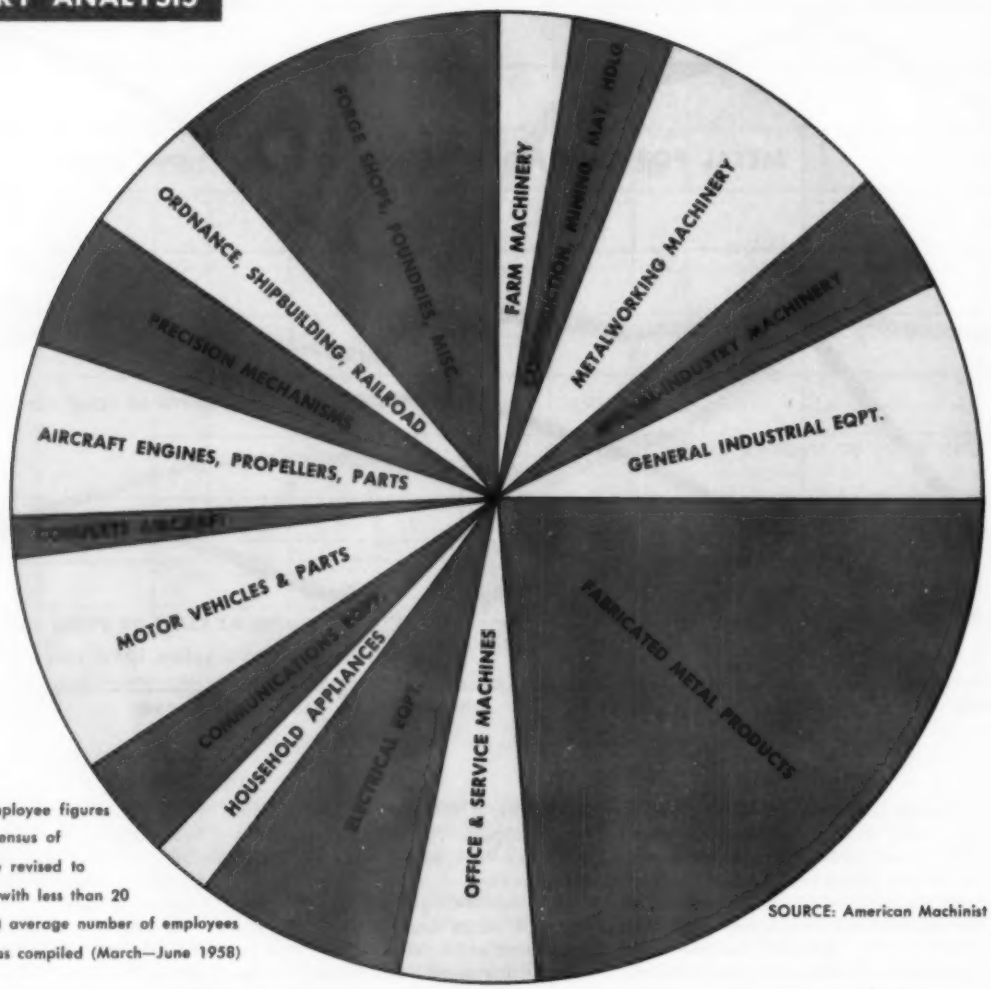
There are 24,872 metalworking plants with 20 or more workers in the United States. They have a total of 6,736,000 employees. These figures come from the 1958 McGraw-Hill Census of Manufacturing Plants. The information on the number of plants and employees on each of the tables in this report is based on this census. In developing the expansion factors additional sources were used to make the equipment tables include plants with less than 20 workers.

In addition to the Inventory of equipment in the Metalworking industry, additional studies were made to cover equipment used for maintenance purposes in other industries. This includes some 250 additional returns. Studies of equipment used for training purposes were expanded to include public high schools in addition to the colleges and vocational institutes covered in previous Inventories. These studies will be found starting on page 89.

From all these special studies added to the basic Inventory, it is possible to estimate the total metalworking resources of the nation at nearly 3 million machines. Details of this estimate will be found on page 10.

This introductory section should conclude with a word about the debt of gratitude due several thousand men who took the time and effort to compile the returns in more than 5800 factories. The basic questionnaire was of necessity complex. In some cases it took hours; in some cases it took days or weeks. It is as a result of their efforts that this Eighth Inventory is made available for their use—and yours.

INDUSTRY ANALYSIS



SOURCE: American Machinist

* In calculations, employee figures for McGraw-Hill Census of Manufactures were revised to include (1) plants with less than 20 employees and (2) average number of employees when Inventory was compiled (March—June 1958)

	TOTALS, MACHINE TOOLS			METAL CUTTING			METAL FORMING			% of Total Equipment in Each Industry	Machines per 100 Employees *
	Units	10 yr & over	Over 20 yr	Units	10 yr & over	Over 20 yr	Units	10 yr & over	Over 20 yr		
Farm Machinery	56,989	72%	27%	45,329	72%	26%	11,660	72%	29%	2.6	51.5
Construction, Mining, Mat. Hdlg.	74,599	63	21	62,496	64	20	12,103	59	24	3.4	36.6
Metalworking Machinery	178,884	62	17	169,304	62	17	9,580	60	23	8.1	67.7
Special-Industry Machinery	91,273	71	23	81,472	71	24	9,801	69	31	4.1	58.4
General Industrial Equipment	160,612	67	19	145,926	66	18	14,686	70	29	7.3	48.5
Fabricated Metal Products	517,860	61	19	326,317	59	16	191,543	65	25	23.3	48.7
Office and Service Machines	94,622	65	24	71,351	66	23	23,271	63	27	4.3	44.5
Electrical Equipment	164,665	57	18	111,406	57	16	53,259	58	21	7.4	31.0
Household Appliances	40,082	64	17	28,830	66	16	11,252	57	17	1.8	29.7
Communications Equipment	72,520	42	7	53,524	42	6	18,996	42	9	3.3	18.5
Motor Vehicles and Parts	163,885	47	20	124,874	46	18	39,011	50	25	7.4	27.0
Complete Aircraft	34,122	51	1	24,962	50	1	9,160	52	1	1.5	8.2
Aircraft Parts	131,323	50	4	116,076	50	3	15,247	49	6	5.9	41.2
Precision Mechanisms	98,091	59	16	81,216	59	15	16,875	60	21	4.4	38.9
Ordnance, Shipbldg., Rways.	92,287	73	20	81,543	72	19	10,744	78	30	4.2	29.7
Forge Shops, F-dries, Misc.	245,928	60	17	182,358	59	16	63,570	63	21	11.0	34.1
	2,217,742	60	18	1,706,984	60	16	510,758	62	23	100.0	36.8

SOURCE: American Machinist

Modernization Concentrated in Two Industries; Over-age Equipment Tops 70% in Three Industries

In three of the sixteen Metalworking industry groups published in this Inventory, over 70% of the machine tools (metal-cutting and metal-forming types) are at least 10 years old. These three industries have about 11% of the machine tools in U. S. Metalworking.

First in machine obsolescence is the industry group comprising Ordnance, Shipbuilding, and Railroads; here 73% of machine tools are at least 10 years old. Almost as high are the Farm Machinery (72%) and Special-Industry Machinery (71%) industries.

Obsolescence in Ordnance, Shipbuilding, and Railroads is intensified by statistics on equipment other than machine tools. This industry group tops all the others in every category: welding equipment (59% at least 10 years old); heating equipment (74%); cleaning and finishing equipment (63%); industrial trucks (52%); and other shop equipment (63%).

Over-age machinery is not confined to a few industries, but is distributed throughout Metalworking pretty evenly. In ten of the sixteen industries, machine-tool age equals or exceeds the Metalworking average of 60% at least 10 years old. These ten industries have 70% of the country's machine tools.

That the average is not higher is due to six industries where modernization—in whole or in part—has been fairly extensive during the past few years. Not surprisingly, all these industries have been forced to modernize, because design and manufacture of many of their products have changed greatly in recent years. To meet consumer and military demands, they have had to scrap their obsolete machines, which in many cases simply couldn't meet production requirements.

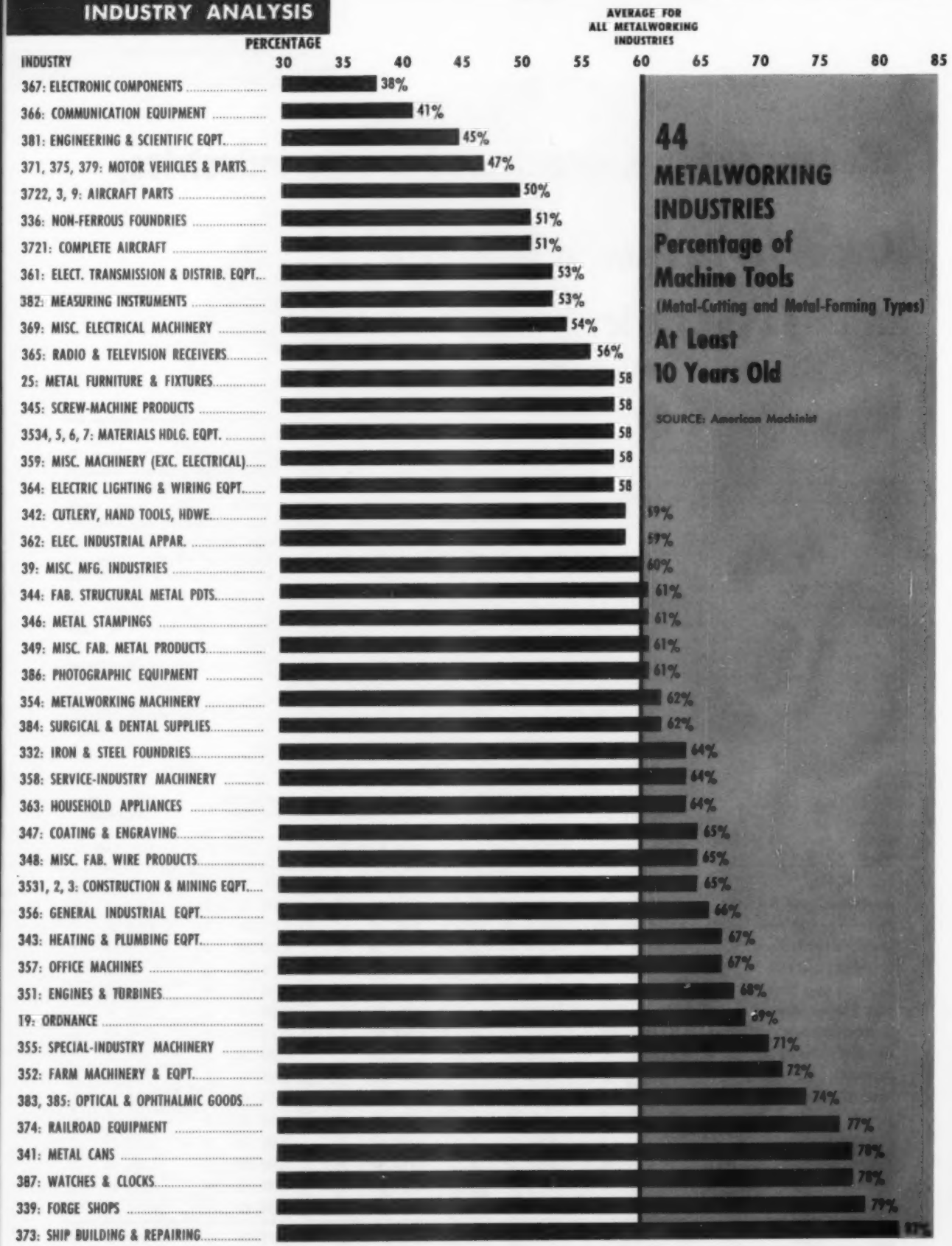
Leader in this group is the Communications Equipment industry, where only 42% of machine tools are at least 10 years old. Others that better the Metalworking average of 60% are Motor Vehicles and Parts (47%), Aircraft Parts (50%), Complete Aircraft (51%), Electrical Equipment (57%), and Precision Mechanisms (59%).

Tables for each industry (or group of industries combined), with breakdowns on

	WELDING EQUIPMENT			HEATING EQUIPMENT			CLEANING & FINISHING			INDUSTRIAL TRUCKS			OTHER SHOP EQUIPMENT		
	Units	10 yr & over	Over 20 yr	Units	10 yr & over	Over 20 yr	Units	10 yr & over	Over 20 yr	Units	10 yr & over	Over 20 yr	Units	10 yr & over	Over 20 yr
Farm Machinery	8,053	49%	7%	2,951	66%	18%	1,423	59%	20%	4,180	48%	5%	1,750	63%	15%
Construction, Mining, Mat. Hdlg.	20,997	38	3	3,017	53	14	1,971	46	7	4,545	26	3	2,313	52	11
Metalworking Machinery	5,411	46	7	6,617	63	13	2,641	41	7	2,893	36	2	4,382	49	9
Special-Industry Machinery	8,324	48	5	2,405	64	16	1,848	50	19	2,103	37	5	2,612	56	11
General Industrial Eqpt.	11,330	47	7	7,055	54	14	5,111	48	10	4,255	31	1	5,245	50	9
Fabricated Metal Products	112,755	50	5	18,024	55	14	18,225	51	14	20,541	36	4	17,043	48	9
Office & Service Machines	9,767	47	9	2,616	50	10	2,956	55	21	5,080	37	6	2,004	49	8
Electrical Equipment	14,044	48	10	8,721	42	10	6,241	42	7	5,214	31	2	4,780	40	6
Household Appliances	6,190	43	6	1,475	58	11	1,714	50	11	2,074	28	2	1,004	52	12
Communications Equipment	7,443	18	2	6,047	17	2	3,537	30	3	1,594	15	1	1,904	30	3
Motor Vehicles & Parts	34,906	28	5	8,930	42	15	5,970	27	7	9,395	21	4	4,615	35	13
Complete Aircraft	2,584	49	0	772	47	1	756	51	1	2,468	18	0	564	27	0
Aircraft Parts	9,877	30	1	6,123	46	2	4,647	41	1	3,225	25	0	3,317	40	1
Precision Mechanisms	3,858	51	6	4,772	38	9	3,962	48	9	1,155	27	1	2,330	40	2
Ordnance, Shipbldg., Rways.	22,973	59	4	5,316	74	21	3,470	63	6	6,781	52	11	1,534	63	10
Forge Shops, Foundries, Misc.	21,199	53	5	14,183	62	15	16,513	52	15	7,392	40	6	8,935	50	11
	299,711	46	5	99,024	52	12	80,985	47	11	82,895	34	4	64,332	47	9

SOURCE: American Machinist

INDUSTRY ANALYSIS


AVERAGE FOR ALL METALWORKING INDUSTRIES
PERCENTAGE
INDUSTRY
30 35 40 45 50 55 60 65 70 75 80 85
367: ELECTRONIC COMPONENTS 38%
366: COMMUNICATION EQUIPMENT 41%
381: ENGINEERING & SCIENTIFIC EQPT. 45%
371, 375, 379: MOTOR VEHICLES & PARTS 47%
3722, 3, 9: AIRCRAFT PARTS 50%
336: NON-FERROUS FOUNDRIES 51%
3721: COMPLETE AIRCRAFT 51%
361: ELECT. TRANSMISSION & DISTRIB. EQPT. 53%
382: MEASURING INSTRUMENTS 53%
369: MISC. ELECTRICAL MACHINERY 54%
365: RADIO & TELEVISION RECEIVERS 56%
25: METAL FURNITURE & FIXTURES 58
345: SCREW-MACHINE PRODUCTS 58
3534, 5, 6, 7: MATERIALS HDLG. EQPT. 58
359: MISC. MACHINERY (EXC. ELECTRICAL) 58
364: ELECTRIC LIGHTING & WIRING EQPT. 58
342: CUTLERY, HAND TOOLS, HDWE. 59%
362: ELEC. INDUSTRIAL APPAR. 59%
39: MISC. MFG. INDUSTRIES 60%
344: FAB. STRUCTURAL METAL PDTS. 61%
346: METAL STAMPINGS 61%
349: MISC. FAB. METAL PRODUCTS 61%
386: PHOTOGRAPHIC EQUIPMENT 61%
354: METALWORKING MACHINERY 62%
384: SURGICAL & DENTAL SUPPLIES 62%
332: IRON & STEEL FOUNDRIES 64%
358: SERVICE-INDUSTRY MACHINERY 64%
363: HOUSEHOLD APPLIANCES 64%
347: COATING & ENGRAVING 65%
348: MISC. FAB. WIRE PRODUCTS 65%
3531, 2, 3: CONSTRUCTION & MINING EQPT. 65%
356: GENERAL INDUSTRIAL EQPT. 66%
343: HEATING & PLUMBING EQPT. 67%
357: OFFICE MACHINES 67%
351: ENGINES & TURBINES 68%
19: ORDNANCE 69%
355: SPECIAL-INDUSTRY MACHINERY 71%
352: FARM MACHINERY & EQPT. 72%
383, 385: OPTICAL & OPHTHALMIC GOODS 74%
374: RAILROAD EQUIPMENT 77%
341: METAL CANS 78%
387: WATCHES & CLOCKS 78%
339: FORGE SHOPS 79%
373: SHIP BUILDING & REPAIRING 87%
44
METALWORKING INDUSTRIES
Percentage of Machine Tools
(Metal-Cutting and Metal-Forming Types)
At Least 10 Years Old
SOURCE: American Machinist

167 major types of machines and equipment, appear on pages 21 through 36. As in previous Inventories, each industry is identified by code numbers from the Standard Industrial Classification (SIC) Manual, the government publication that identifies and codes industries according to their principal products.

New Machines Increase Capacity

The degree to which the Communications Equipment industry has modernized can be seen by setting present figures against those of five years ago. In 1953, 47% of machine tools were at least 10 years old; today average machine age is 5% less.

The effect of this modernization has been to increase capacity significantly. A recent study shows that capacity of the Electrical Machinery industry (of which Communications Equipment forms a part) has increased roughly 60% since 1953 (see "Where Metalworking Is Headed," *AM*—Mar 10 '58, p118).

This striking increase in capacity, not possible without new equipment, proves that the investment in modernization has paid off handsomely. Principal products in the Communications Equipment industry include radio and television receiving sets, telephone and telegraph apparatus, radio and TV transmitting and signalling apparatus, and electronic components. The military have also made huge investments here in aircraft and missile control systems.

Just as significant is the increase in capacity in the automotive industry, up 33% from 1953. The degree of modernization has been even greater: Percentage of machine tools over 10 years old, which was 57% five years ago, is only 47% today.

Automation is chiefly responsible for the large increase in capacity in the Motor Vehicle industry. In 1953, this industry had 220,000 machine tools; today it has 163,000. Even with this tremendous drop, capacity has risen steeply. Single multi-station machines that replace ten or twenty obsolete machines provide the answer to this apparent incongruity. The automotive industry has slightly more than half of the 16,000 special multi-station machines in Metalworking.

The Farm Machinery industry is a good example of what happens when machine-replacement programs are neglected by an industry as a whole. Capacity here has risen only about 10% in the past five years. There has been only spotty replacement of really obsolete machines. This industry leads all others in the amount of machine tools over 20 years old: 27%. The same poor record is obvious in plants that make Special-Industry Machinery; 23% of machines are over 20 years old, on the average.

The Precision Mechanisms industry, which the last Inventory revealed as the most replacement-conscious in Metalworking, now has 59% of machine tools at least 10 years old, compared to 44% in 1953. Another industry noted in the past for the comparative youth of its equipment, Complete Aircraft, now has machine tools that average 51% at least 10 years old, compared to 44% five years ago. Although machine age in both of these industries is below the national average, equipment here is noticeably aging.

METAL-CUTTING MACHINE TOOLS: CHANGES IN FIFTEEN INDUSTRIES THROUGH EIGHT INVENTORIES

	Percentage at least 10 years old							
	1925	1930	1935	1940	1945	1949	1953	1958
Farm Machinery	65%	58%	60%	69%	55%	50%	50%	72%
Construction, Mining, Materials Handling	—	49	74	73	49	48	58	64[1]
Metalworking Machinery	—	—	66	71	45	43	60	62
Special-Industry Machinery	56	45	76	74	57	54	62	71
General Industrial Equipment	52	47	75	78	54	44	55	66[2]
Fabricated Metal Products	59	49	70	76	47	45	52	59
Office & Service Machines	—	53	73	69	58	48	53	66
Electrical Equipment	45	51	65	70	47	37	51	57
Communications Equipment								42
Household Appliances	—	46	60	69	47	38	43	66
Motor Vehicles & Parts	27	27	55	63	37	56	57	46
Complete Aircraft	—	3	13	29	2	16	45	50
Aircraft Engines, Propellers, & Parts							51	50
Precision Mechanisms	—	—	—	61	36	35	45	59
Ordnance, Shipbuilding, Railroads	—	55	—	77	40	38	64	72
Metal-Cutting Average	44%	52%	67%	72%	38%	43%	55%	60%

SOURCE: American Machinist

NOTES: Percentages in some Inventories have been adjusted so that data will be comparable. Recent changes in SIC industry codes make it impossible to classify some industries exactly, especially in the earlier Inventories. Blanks mean no comparable data are available.

1. Figures before 1958 do not include Materials Handling Equipment industry.

2. 1958 figure includes Engines and Turbines industry, which is not included with General Industrial Equipment in earlier Inventories.

Machines and Employees

Concentration of machines per 100 employees for each industry appears in the table on page 6. The Metalworking Machinery industry leads all others here, with 67.7 machine tools for every hundred employees. In the 1953 report, Special-Industry Machinery plants showed the greatest concentration, but today are in second place (58.4). Lowest concentration of machines per 100 employees (8.2) is in the Complete Aircraft industry, which held the same relative position in 1953.

These figures make for interesting comparisons, but should not be taken as gospel. Below-capacity work in an industry will lower the ratio between machines and employees; two- or three-shift work will raise it.

Analyzing the Industry Tables

Employment figures given with each industry table are from the McGraw-Hill Census of Manufactures. To get a valid basis for expanding equipment in the actual returns in terms of employees, these

employment figures have been adjusted in two ways: (1) to include plants with less than twenty employees, which the Census does not list; and (2) to reflect average employment during the March-May 1958 period when the majority of plants, each listing its current employment, sent in their returns.

The system outlined in the Standard Industrial Classification (SIC) Manual, a government publication that assigns code numbers to industries according to their principal products, was followed in the Inventory. As each plant's return came in, it was assigned a 4-digit SIC code that put the plant into 1 of 44 metalworking industries. For example, for a plant that makes cutlery, the SIC code is 3421; a plant that produces conveyors is assigned SIC code 3535.

These SIC code numbers need to be studied carefully, especially if comparisons are made between industry tables in the 1953 and 1958 Inventories. Here's why: The 1953 Inventory was based upon industry classifications in the 1945 SIC Manual, which was revised extensively in 1957. Because the new Inventory follows the new SIC Manual, industries that apparently are the same in both Inventories do not necessarily cover the same plants or the same principal products. For example, the Materials Handling industry, formerly classified in the General Industrial Machinery industry, is now grouped with makers of construction and mining machinery. That an industry is now much larger (or smaller) than it was five years ago does not necessarily mean that it has grown or decreased; a careful check of the old and new SIC manuals will show whether this condition is true.

Nearly Three Million Machine Tools in US; Three Quarters of Total in Metalworking

There are an estimated 2,887,000 machine tools (metal-cutting and metal-forming types) in the United States today. 61% of this equipment, about 1,750,000 units, is at least 10 years old. 19%, or 550,000 units, are more than 20 years old.

These machine tools are located in four areas:

1. Metalworking industries, which are the chief concern of the Inventory.

2. Other industries: primary metals, railroad maintenance shops, air transport maintenance, manufactured non-metallic products, public utilities, process industries, and mining, lumbering, and construction industries. A special survey on machine tools used for maintenance in these industries appears on pages 89 through 95.

3. In storage and surplus: This area includes government-owned machine tools in storage, as well as new and used machine tools in the hands of builders and distributors.

4. Colleges, vocational institutes, and high schools. A special survey on tools in training institutions appears in the maintenance survey.

Metalworking industries, with 2,218 machine tools or 77% of the total, have by far the greatest number of units. Metalworking has 78% of the country's metal-cutting tools and 75% of the metal-forming units. These figures include units used in metalworking tool rooms and maintenance shops as well as production lines.

Machine tools used for maintenance in non-metalworking industries total 490,000 units, or 17% of all units. The remaining 6% of the U.S. total are found in training institutions and in surplus or storage. Estimates of actual numbers appear in the table on this page.

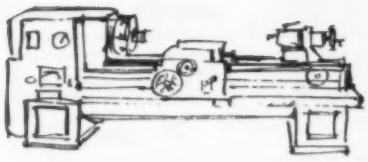
It is estimated that government agencies own about 270,000 machine tools, or roughly 12% of the production equipment now in Metalworking. At the end of World War II this figure was 33%. In 1949 it was 13% and in 1953 it reached 18%.

Government-owned machine tools now in private or government plants are included in the industry and area tables that make up the main section of the Inventory. In-storage units owned by the government are included in the table on this page.

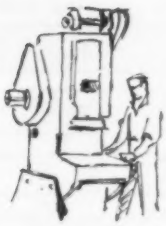
Age distribution and quantities for total U.S. machine tools follow the trend noted in machine tools used for production and maintenance in metalworking industries. In 1953 the U.S. total was 2,975,000 units, of which 56% were at least 10 years old and 22% were more than 20 years old. Today 61% of the 2,887,000 units are at least 10 years old and 19% are more than 20 years old.

ESTIMATED TOTAL EQUIPMENT IN THE UNITED STATES

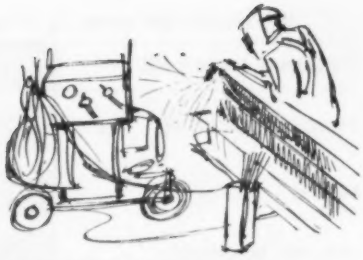
SOURCE: American Machinist	TOTAL MACHINE TOOLS			METAL-CUTTING MACHINE TOOLS			METAL-FORMING MACHINE TOOLS		
	Total Units	10 yr & over	Over 20 yr	Total Units	10 yr & over	Over 20 yr	Total Units	10 yr & over	Over 20 yr
METALWORKING INDUSTRIES	2,218,000	60%	18%	1,707,000	60%	16%	511,000	62%	23%
OTHER INDUSTRIES	490,000	61	26	350,000	62	27	140,000	58	24
IN STORAGE & SURPLUS	110,000	60	18	82,000	60	16	28,000	62	23
TRAINING	69,000	77	23	65,000	77	23	4,000	70	19
TOTAL	2,887,000	61	19	2,204,000	61	18	683,000	61	23



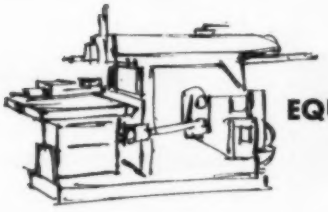
METAL CUTTING:
1,707,000 machines
60% at least 10 yrs. old
16% over 20 yrs. old



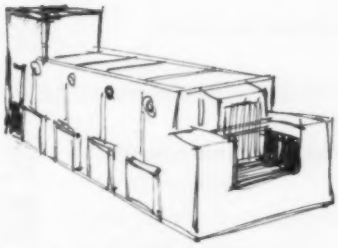
METAL FORMING:
511,000 machines
61% at least 10 yrs. old
23% over 20 yrs. old



WELDING EQUIPMENT:
300,000 units
45% at least 10 yrs. old
5% over 20 yrs. old



EQUIPMENT ANALYSIS



CLEANING & FINISHING:
81,000 units
47% at least 10 yrs. old
11% over 20 yrs. old

Drop in Percentage Over 20 Years Old Fails to Halt Trend to Obsolescence

Careful study of the Eighth Inventory produces two highly interesting but apparently contradictory facts on the age distribution of major equipment types:

- **The percentage of machine tools at least 10 years old has increased during the past five years (from 56% to 60%).**
- **The percentage of machine tools over twenty years old has decreased since 1953 (from 20% to 18%).**

These statements are valid for almost every type of machine tool, both metal-cutting and metal-forming types. In 27 of the 29 major classes of machine tools common to both the 1953 and 1958 Inventories, the percentage over 10 years old is *higher* in 1958. In 26 of these 29 machine types, the percentage over 20 years old *equals or is lower* in 1958 than in 1953.

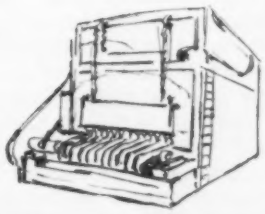
This same seeming anomaly shows up in the age distribution of equipment other than machine tools. The percentage of equipment over 10 years old is higher, while that over 20 years old is lower than in 1953.

Only one conclusion is possible: Metalworking is getting rid of thousands of really obsolete machines, but it isn't doing so fast enough to stop the trend toward obsolescence. This trend, a post-war development first noted in the 1949 Inventory, still is the most significant news in this report (see the table on page 15 for confirmation of the trend). But the news that many machine tools over twenty years old are being scrapped is the most optimistic feature of a generally bleak picture.

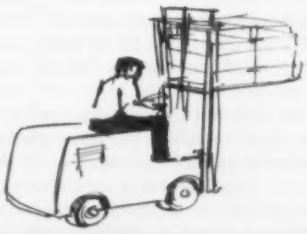
Even the trend toward obsolescence is in one sense not so dismal as five years ago. The 1953 Inventory showed an average 12% jump in machine tools over 10 years old compared to machine statistics for 1949. That the 4% jump in obsolescence during the past five years is no greater is due chiefly to the drop in over-20-year-old units.

Metal-Cutting Machine Tools— 10% to 85% over 10 years old

Quite naturally, the age distribution of the 19 types of metal-cutting machine tools covered in the Inventory varies widely. In only seven of these types does the percentage of machines over 10 years old equal or exceed the total equipment average of 60%. **But these seven types contain six out of every ten metal-cutting tools in all age groups. And if drilling machines (at 59% only 1% below the over-10-years-old average) were added to this group, eight out of every ten metal-cutting machines would be represented.**

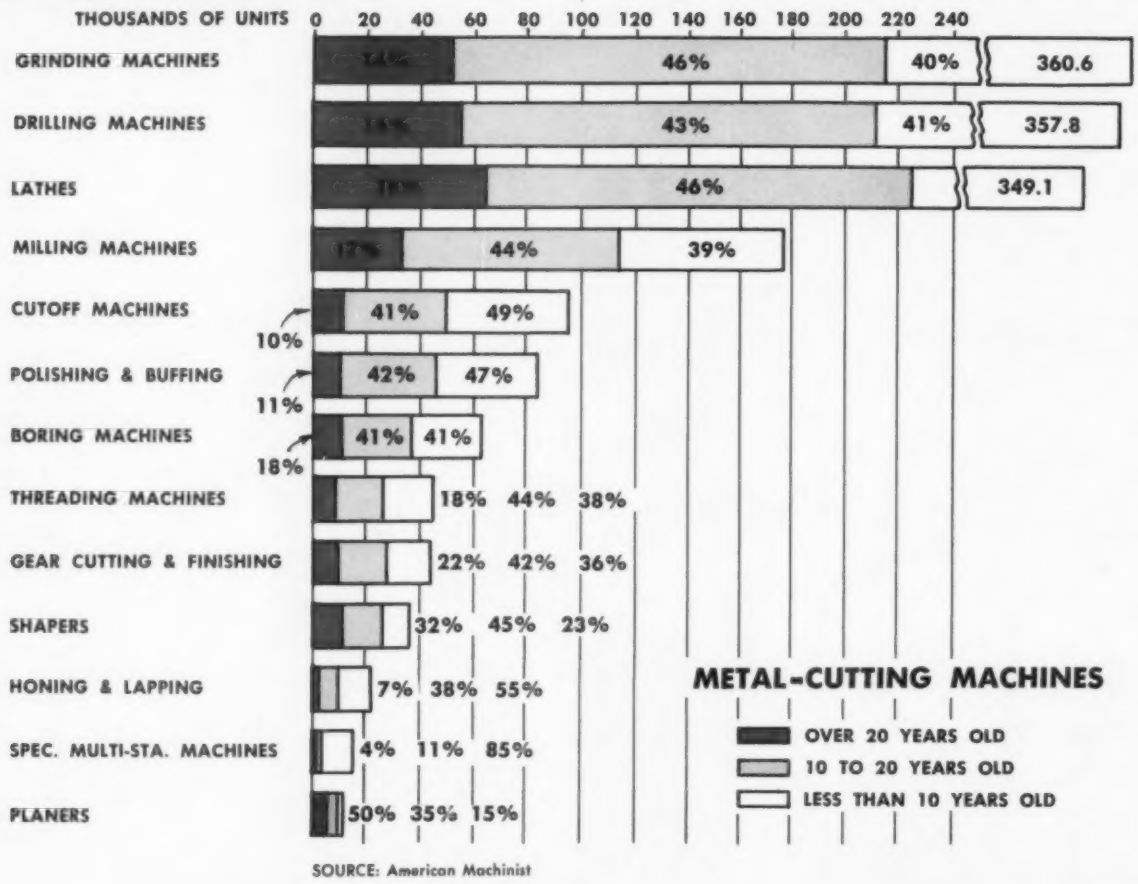


HEATING EQUIPMENT:
99,000 units
52% at least 10 yrs. old
12% over 20 yrs. old



INDUSTRIAL TRUCKS:
83,000 units
34% at least 10 yrs. old
4% over 20 yrs. old

EQUIPMENT ANALYSIS



SOURCE: American Machinist

Oldest of metal-cutting machines are planers—85% are at least 10 years old, 50% over 20 years old. Of the 12,300 planers in Metalworking, less than 2,000 were built within the last ten years. Almost one quarter of these new planers are in the Metalworking Machinery industry, which has the largest total number of planers in Metalworking.

Shapers—there are almost 36,000 in all of Metalworking—follow planers in average age distribution. 77% of these machines are at least 10 years old, 32% over 20 years old. Of the 8,400 shapers built since 1948, slightly more than 2,000 are in the Fabricated Metal Products industry, which has more shapers of all age groups than any other.

The contrast between planers and ultrasonic cutting machines is great; the contrast between their industrial age is even greater. This machine type, included for the first time in an Inventory, is almost entirely of recent manufacture. Only 10% of a total of 178 ultrasonic cutting machines in the nation are over 10 years old. The smallest of metal-cutting machines both in quantity and in percentage at least 10 years old, ultrasonic cutting machines are distributed chiefly in four of the sixteen industries in the Inventory. The largest number, 39, are in the Communications Equipment industry.

Almost as exotic, and also introduced in the new Inventory, are electro-erosion machines. Of the 578 in Metalworking, only 13% are at least 10 years old. 120 of these machines are in the Aircraft Engines, Propellers, and Parts industry; 112 are in the Metalworking Machinery industry.

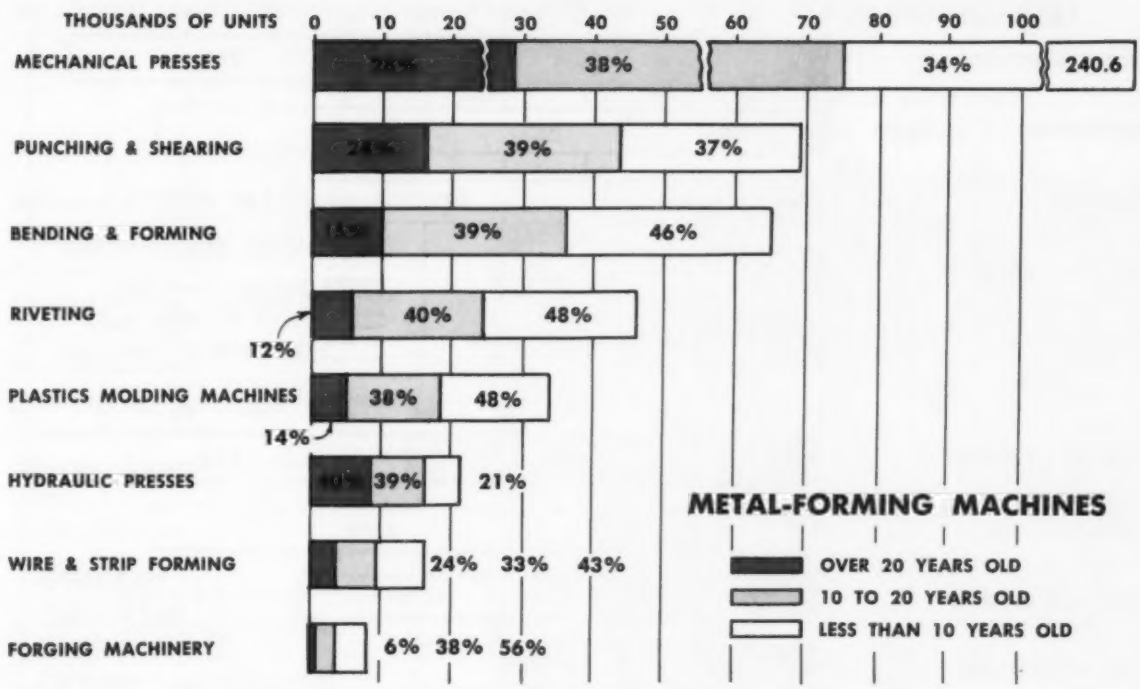
Special multi-station machines, the tools of automation, have also been included in the Inventory for the first time. 15% are at least 10 years old. Of the more than 16,000 machines of this type in Metalworking, more than half are in the Automotive industry.

Much has already been said, earlier in this report, about the impact of these machines on certain industries. That they have increased productivity is clear. That they have caused a decrease in the total number of metal-cutting machines in Metalworking is equally clear. This latter statement, shocking as it might seem at first glance, actually carries a hopeful connotation, if one agrees that productivity is a better gage of progress than machine quantity.

It is necessary to be cautious when speaking about the quantity of special multi-station machines. A transfer machine is one machine, whether it contains 10 or 100 stations. One plant may have twenty two-station machines that combined are smaller than one 50-station machine in another plant. Machines of both types are included in the Inventory totals. In this Inventory it was impractical to classify these special multi-station machines by size or by capacity. Literal comparison by sheer quantity of these machines in area or industry tables can be misleading.

4% of special multi-station machines are more than 20 years old. The bulk of these are dial or rotary-table machines found in two or three industries.

Obsolescence in metal-cutting machines really shows up in percentages for standard, long-used equipment. These machines, which in sheer quantity account for practically all of metal-cutting machines, have the same age distribution described earlier: a higher percentage than five years ago of units at least 10 years



SOURCE: American Machinist

old, a lower percentage of units more than 20 years old. The shift in age distribution since World War II can be most clearly seen in the table on page 15.

The decrease in total metal-cutting machines has produced changes in the number of units in several major types of machines. Today there are more grinding machines (360,000) in metal-cutting than any other types of machine. Drilling machines (358,000) are second. The leader in 1953, lathes, is now in third position (349,000).

The new Inventory shows that only three types of metal-cutting machines have increased in total number since 1953. Contour sawing and filing machines are up from 15.6 thousand to 17.5 thousand; cutoff-machine totals have risen from 89.7 thousand to 94.9; and honing and lapping totals are up from 19 thousand in 1953 to 20.8 thousand today. The greatest numerical drop in the past five years has been in lathe totals (from 425,000 to 349,000). A smaller number of new, faster machines have replaced obsolete units that were superior only in quantity.

Metal-Forming Machine Tools—30% to 80% over 10 years old

The obsolescence pattern of metal-forming machines is similar to that for metal-cutting; the only difference is that the average metal-forming machine is a bit older. 62% of these machines are at least 10 years old; 23% of the total are at least 20 years old. Metal-forming equipment generally tends to be retained in use longer than most metal-cutting equipment.

Changes since 1953 in the age distribution of metal-forming machines are similar to those in metal cutting. In 9 of the 10 major machine types in this category, the percentage at least 10 years old is higher than in 1953; the percentage of machines over 20 years old is lower in all ten types.

The 80%-at-least-10-years-old average of forging machinery makes this type the oldest in metal-forming equipment. Four out of every ten of these machines are more than 20 years old.

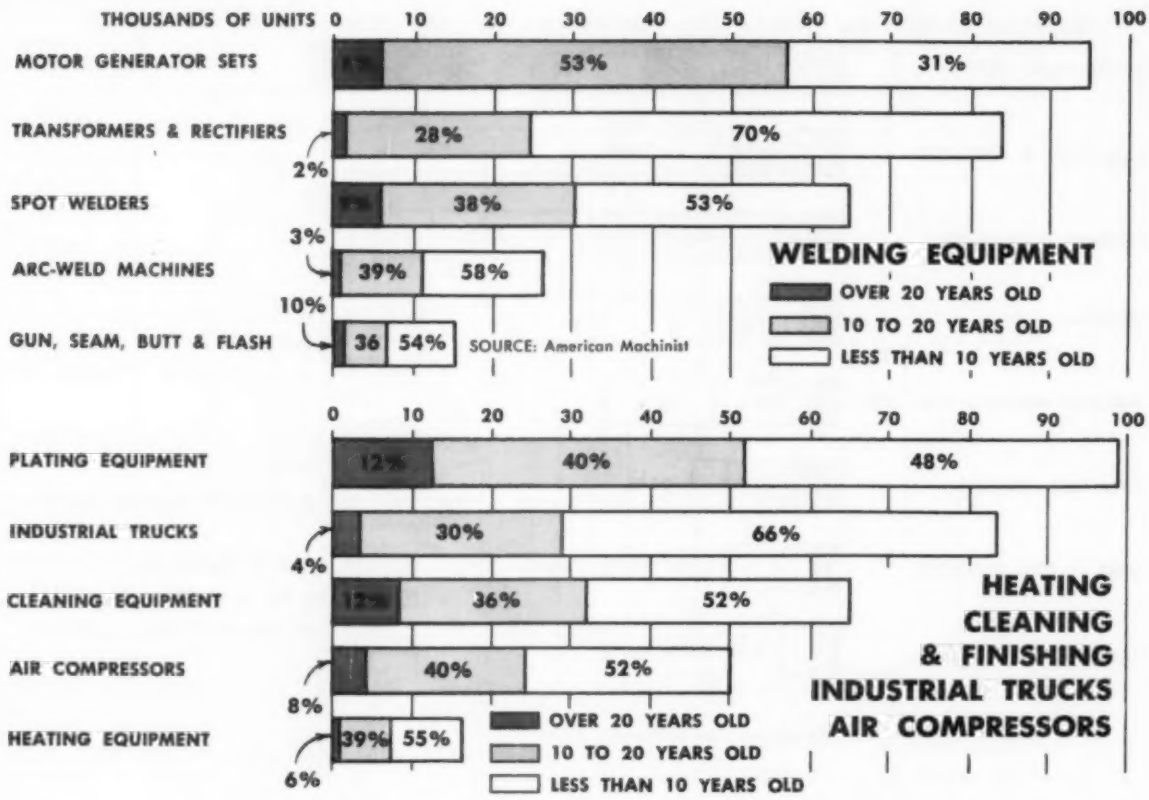
The most striking reversal of the obsolescence trend in metal forming since 1953 is in die-casting machines. Five years ago 46% were at least 10 years old; today this percentage has dropped to 30%. Chief cause of this extensive modernization is the great increase recently in aluminum die-casting. Of the 1300 die-casting machines in Metalworking, more than a thousand are in non-ferrous foundries.

There are roughly the same number of metal-forming machines of all age groups today (511,000) as in 1953 (532,000). This slight drop in total units is in striking contrast to the decline in total metal-cutting machines during the past five years. Automation has not affected metal forming to the extent that it has the metal-cutting aspects of Metalworking. Too, when an obsolete metal-forming machine is replaced, it is more likely to be on a one-for-one basis than in replacement of metal-cutting machinery.

Equipment Other Than Machine Tools—34% to 52% at least 10 years old

Heating equipment continues to be the oldest in that portion of Metalworking outside machine tools. More than half (52%) of this equipment is at least 10 years old. The current Inventory gives statistics on seven types of heating equipment. Two of these types—heat-treating furnaces and stock-heating furnaces—account for 54,000 of the 99,000 heating units reported. Because average age of these types exceeds 60% at least 10 years old, the average age of all heating equipment rises proportionately.

Welding equipment, including both welding machines and power sources, averages 45% at least 10 years old. This compares with 39% in the same age group five years ago. It should be remembered that this Inventory covers only welding machines—not hand welding equipment.



SOURCE: American Machinist

Totals in this report include only welding equipment in the 16 industry groups reported on. Today there are 284,000 units of electric welding equipment in Metalworking, compared to 266,000 five years ago. Numerically, there have also been increases in gas welding machines (from 2,645 to 3,357) and flame cutting machines (from 11,580 to 12,760).

Comparisons in other equipment totals for 1953 and 1958 are difficult to make, especially in cleaning and finishing equipment. The type of equipment covered in both Inventories varies somewhat, and exact comparisons are not possible in certain cases. Today 48% of cleaning equipment is at least 10 years old; 44% of plating equipment falls into the same age group.

Breakdown on industrial trucks for the new Inventory is the same as in 1953. Today 34% of these are at least 10 years old, compared to 28% five years ago. Percentage of trucks over 20 years old, however, has decreased slightly from 5% to 4% of the total during this period.

Changes Since 1945

The table on page 15 shows percentages of equipment at least 10 years old for every Inventory since the end of World War II. In most types, percentage rise since 1945 has been fairly consistent from Inventory to Inventory. For example, the at-least-10-years-old average of 38% for machine tools at the end of World War II has risen 22% in the past thirteen years to the present 60%.

Some equipment is replaced more often than others. If we compare the first and last columns in the table, we get a reliable gauge of what equipment is being replaced most rapidly and what is being allowed to become obsolete.

Biggest increase in metal-cutting machine tools at least 10 years old is in gear cutting and finishing machines: In 1945, only 30% were at least 10 years old; today 64% fall into this age classification. Not far behind are grinding machines, with a 30% rise (from 30% at least 10 years old in 1945 to 60% today).

Smallest increase, on the other hand, has been in average age of pipe cutting and threading machines. The percentage here of units at least 10 years old has risen only 5% since 1945, from 49% to 54%.

In metal-forming machine tools, forging machinery has aged most rapidly, on the average, since 1945. 48% of these were at least 10 years old when World War II ended; today the figure is 80%, representing a 32% rise in the past 13 years. Hydraulic presses, on the other hand, have increased in this respect only 1% (from 51% to 52%). In general, the percentage gap between 1945 and 1958 is not nearly so great for metal-forming units as for metal cutting. In 1945 metal-forming units tended to be older, on the average, than metal-cutting tools. Their average age today is slightly greater, too.

In most cases, a rise in the percentage of machines at least 10 years old indicates that machines are not being replaced. The greater the rise, the smaller the degree of replacement. In some types of machines, however, the percentage increase since 1945 may have been slight, even though most of the old machines are still in use. The answer here is that many new units have been bought in recent years, thus slowing down obsolescence.

In equipment other than machine tools, greatest percentage rise has been in welding equipment. At the end of World War II, only 15% of this equipment was at least 10 years old; today welding equipment in this category averages 45%.

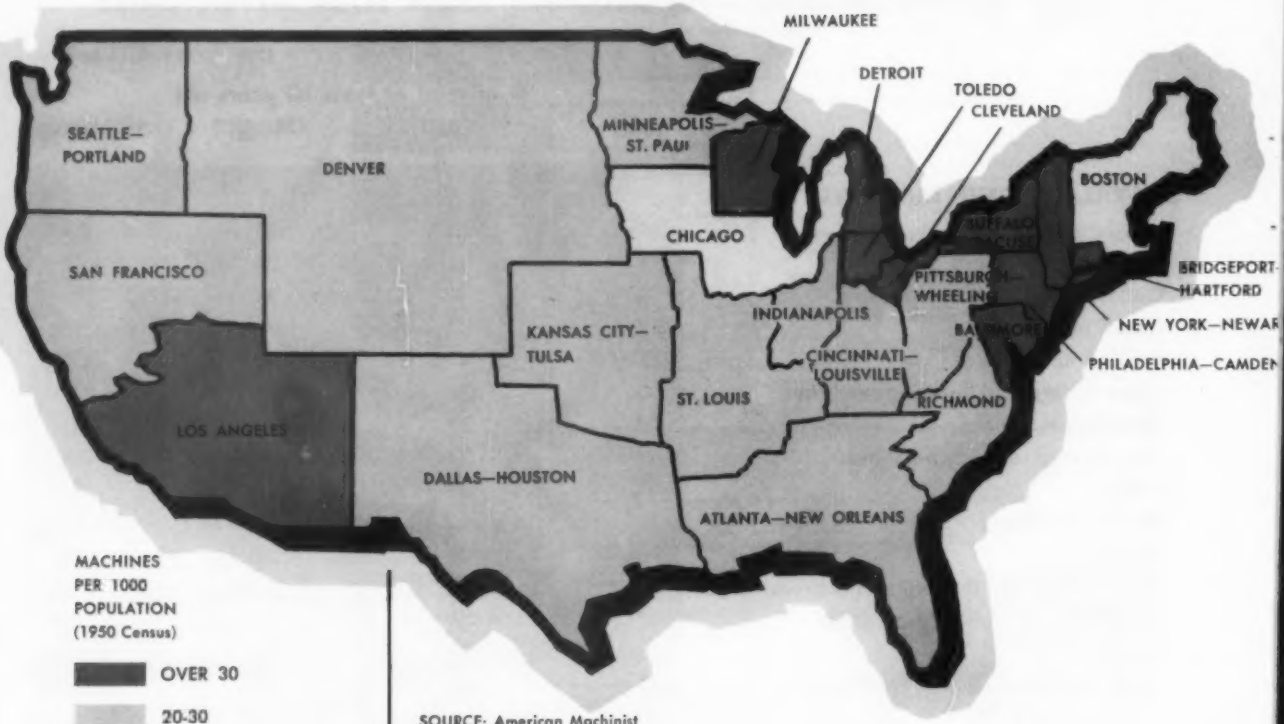
Complete figures for all major classes of equipment appear in tables on pages 61 through 88. These tables include statistics on equipment in each of the 24 geographical areas and each of the 16 industries.

HOW EQUIPMENT AGES—PERCENTAGES FROM FOUR INVENTORIES

	% of total at least 10 years old			
	1945	1949	1953	1958
METAL-CUTTING MACHINE TOOLS				
Boring machines	34%	43%	55%	58%
Broaching machines	35	31	50	59
Contour sawing and filing machines	—	—	36	49
Cutoff machines	34	33	45	51
Drilling machines	38	41	53	59
Gear cutting and finishing machines	30	50	58	64
Grinding machines	30	37	53	60
Honing and lapping machines	13	24	44	45
Lathes	41	47	58	64
Milling machines	37	45	59	61
Planers	78	75	81	85
Pipe cutting and threading machines	49	46	51	54
Polishing and buffing machines	41	39	51	53
Shapers	64	63	69	77
Threading (except pipe) machines	40	54	61	62
METAL-FORMING MACHINE TOOLS				
Bending and forming machines	46	50	51	54
Wire and strip forming machines	—	67	57	57
Hydraulic presses	51	37	46	52
Pneumatic presses	—	18	33	45
Mechanical presses	61	61	63	66
Punching and shearing machines	—	59	61	63
Forging machinery	48	72	73	80
Riveting machines (not hand)	35	39	46	52
Die casting machines	—	17	46	30
Plastics molding machines	—	33	42	44
EQUIPMENT OTHER THAN MACHINE TOOLS				
Welding equipment	15	29	39	45
Heating equipment	34	29	50	52
Cleaning equipment	—	36	45	48
Plating equipment	26	28	39	44
Industrial trucks	—	23	28	34
Air compressors	44	28	41	48
Balancing machines	—	38	45	43

Note: Where blank spaces occur, no comparable data exist.

SOURCE: American Machinist



SOURCE: American Machinist

No.	AREA	MACHINE TOOLS OVER 10 yrs. OLD
1	BOSTON	67%
2	BRIDGEPORT—HARTFORD	66
3	NEW YORK—NEWARK	59
4	BUFFALO—SYRACUSE	63
5	PHILADELPHIA—CAMDEN	62
6	PITTSBURGH—WHEELING	68
7	BALTIMORE	64
8	RICHMOND	59
9	ATLANTA—NEW ORLEANS	63
10	CLEVELAND	61
11	TOLEDO	54
12	CINCINNATI—LOUISVILLE	63
13	DETROIT	56
14	INDIANAPOLIS	61
15	CHICAGO	59
16	MILWAUKEE	68
17	MINNEAPOLIS—ST. PAUL	57
18	ST. LOUIS	68
19	KANSAS CITY—TULSA	60
20	DALLAS—HOUSTON	45
21	DENVER	63
22	SEATTLE—PORTLAND	68
23	SAN FRANCISCO	58
24	LOS ANGELES	41
	AVERAGE	60

Shifts in Machine Concentration:

East Down, Rest of Country Up

● **The Richmond area (see map above) has 87% more machine tools today than in 1953.** New metalworking industries in Virginia, North Carolina, and South Carolina have given this area the nation's biggest percentage rise in machine tools (metal-cutting and metal-forming types) during the past five years. Metal-cutting machines are up 84% here, and the number of metal-forming machines has doubled.

● **Machine tools in the Los Angeles area have increased 16% since 1953.** Five years ago, this area was the fastest growing in Metalworking. It is still growing, but not so rapidly as before.

● **Metalworking totals in New England, on the other hand, have decreased in the past five years.** There are 20% fewer machine tools in the Boston area and 27% fewer in the Bridgeport—Hartford area. In the neighboring New York – Newark area, machine-tool totals have dropped 17%.

For many years there has been a saying that US Metalworking is located east of the Mississippi River and north of the Ohio. There is still a lot of truth in this statement: Today 87.6% of the nation's machine tools are in the Northeastern and Midwestern states. The likelihood that this pattern will change drastically within the next few years is slight. Yet the current Inventory, like the previous one, does show that Metalworking is spreading slowly but surely beyond its traditional boundaries.

To get a clearer picture of this expan-

GEOGRAPHICAL DISTRIBUTION OF MACHINE TOOLS

AREA	MACHINE TOOLS	% OF TOTAL EQUIPMENT IN EACH AREA	MACHINES PER 100 EMPLOYEES *	1950 POPULATION 1000's	MACHINES PER 1000 POPULATION
Boston	173,040	7.8%	54.1	7,307	23.7
Bridgeport—Hartford	125,271	5.7	54.0	2,007	62.6
New York—Newark	202,488	9.2	39.8	12,589	16.1
Buffalo—Syracuse	100,300	4.5	28.3	5,729	17.5
Philadelphia—Camden	105,835	4.8	28.5	7,918	13.4
Pittsburgh—Wheeling	65,247	2.9	32.0	6,743	9.7
Baltimore	32,045	1.4	34.5	3,034	10.6
Richmond	38,170	1.7	38.6	9,498	4.0
Atlanta—New Orleans	45,652	2.1	24.8	16,465	2.8
Cleveland	126,615	5.7	44.2	3,515	35.9
Toledo	35,668	1.6	42.0	1,146	31.1
Cincinnati—Louisville	106,839	4.8	42.0	5,122	20.8
Detroit	228,408	10.3	41.2	4,670	48.9
Indianapolis	75,007	3.4	36.9	2,995	25.1
Chicago	325,304	14.7	39.7	12,381	26.2
Milwaukee	93,146	4.2	40.2	3,096	30.1
Minneapolis—St. Paul	30,652	1.4	38.8	3,530	8.7
St. Louis	43,984	2.0	26.5	7,713	5.7
Kansas City—Tulsa	27,425	1.2	22.4	5,369	5.1
Dallas—Houston	38,087	1.7	26.9	8,392	4.1
Denver	20,623	0.9	52.9	6,082	3.4
Seattle—Portland	15,437	0.7	18.2	3,900	4.0
San Francisco	27,202	1.2	29.6	4,551	6.0
Los Angeles	135,297	6.1	26.9	6,945	19.5
Total	2,217,742	100.0	36.7	150,697	14.7

* In calculations, employee figures for McGraw-Hill Census of Manufactures were revised to include (1) plants with less than 20 employees and (2) average number of employees when inventory was compiled (March—June 1958)

sion, we can compare the percentages of total machine tools that each section of the country has. **What apparently is happening is that the Midwest is holding its own, while percentages of the national total for the Northeastern states are slowly decreasing.** Here's what the figures tell us:

1. Today 36.3% of the nation's machine tools are located in the Northeastern states (areas 1 through 7 in the table on page 16). In 1953 the percentage was 40.5%.

2. The Midwest (areas 10 through 19) has 49.3% of the country's machine tools, 2.2% more than it had five years ago.

3. In the South (areas 8, 9, and 20) machine tools reach 5.5% of the national metalworking total. This is a 1.2% increase since 1953.

4. On the Pacific Coast (areas 22, 23, and 24) percentage of total equipment has risen from 7.3% to 8%.

5. The Mountain States (area 21) have 0.9% of the national total, compared to 0.8% five years ago.

The figures presented here don't necessarily mean that Metalworking is leaving the Northeast. Certainly metalworking industries have not left the East to the extent that other industries—textiles and chemicals, for example—have during recent years. What the percentages do show is that Metalworking is growing at a faster rate in every other section of the country.

The striking percentage increase in the Richmond area, even though actual machine figures are small compared to other areas, is a good indication that Metalworking is following the lead of other industries in extending operations to all parts of the country. Before World War II, Metalworking scarcely existed south of the Potomac River. Today it is well established there; the 5.5% of the nation's machine tools now in the Southern states is 28% higher than the 4.3% total five years ago.

Defense projects of the Government have helped develop Metalworking in the South, but many large companies have built new plants there, too, in the past few years. They have come for the same reasons that lure other industries: tax exemptions, relatively untapped labor supply, and cheap power. Metalworking is not yet large enough a force in the South to give other sections of the country cause

for concern, yet its growth today is anything but static.

Old Machines in All Areas

The Los Angeles area, as in the previous Inventory, has the "newest" machine tools in the country. Only 41% are over 10 years old (in 1953, the figure was 34%). Second place belongs to the Dallas-Houston area, where only 45% of machine tools are more than 10 years old. Percentages for all twenty-four areas appear in the tables on pages 16 and 18.

Over-age machine tools are not restricted to one or two sections of the country. In fifteen of the twenty-four areas represented in the Inventory, the percentage of machines at least 10 years old equals or exceeds the national average of 60%.

Just where is the highest percentage of over-ten-years-old machine tools? The Pittsburgh–Wheeling area, or Milwaukee, or St. Louis, or Portland–Seattle? Actually, in all these widely separated areas 68% of the machine tools are at least 10 years old. Here is the most striking proof that obsolescent equipment has no geographical boundary.

This same absence of an area pattern applies to metalworking equipment other than machine tools that is at least 10 years old. The Baltimore area has the highest percentage of cleaning and finishing equipment (65%) and industrial trucks (59%) in this unenviable category. Three thousand miles away, the Seattle–Portland area has the same record for welding equipment (65%) and heating equipment (72%).

What about equipment that is more than 20 years old? This obsolete machinery also is pretty evenly scattered throughout the country. **In thirteen areas, the percentage of machine tools over 20 years old equals or exceeds the national average of 18%.** The Milwaukee area, with a high of 24% in this category, leads the nation. Several other areas, however, are close runners up. In the Los Angeles area, on the other hand, only 4% of machine tools were built before 1939.

The new Inventory clearly shows that all areas have large percentages of obsolescent equipment. **At least two out of every five machine tools in each area are over 10 years old. The national average is three out of five.** And in seven of the twenty-four areas, at least one in five machine tools is over 20 years old. These latter machines were built in the 30's from designs that in many cases date back to the 20's. It is wise to remember that machines, like cliches, age quickly; yesterday's revolutionary design is commonplace today.

	TOTAL MACHINE TOOLS			METAL-CUTTING MACHINES			METAL-FORMING MACHINES		
	Units	10 yr & over	Over 20 yr	Units	10 yr & over	Over 20 yr	Units	10 yr & over	Over 20 yr
Boston	173,040	67%	21%	136,832	67%	20%	36,208	65%	26%
Bridgeport–Hartford	125,271	66	23	102,657	65	22	22,614	69	28
New York–Newark	202,488	59	15	154,675	59	13	47,813	62	20
Buffalo–Syracuse	100,300	63	21	74,266	64	19	26,034	60	26
Philadelphia–Camden	105,835	62	20	77,041	61	18	28,794	64	25
Pittsburgh–Wheeling	65,247	68	23	45,975	66	19	19,272	71	31
Baltimore	32,045	64	19	26,514	64	19	5,531	67	22
Richmond	38,170	59	14	29,589	59	13	8,581	58	19
Atlanta–New Orleans	45,652	63	18	33,904	63	17	11,748	63	22
Cleveland	126,615	61	19	99,956	61	17	26,659	63	26
Toledo	35,668	54	14	27,130	54	14	8,538	54	13
Cincinnati–Louisville	106,839	63	23	81,038	64	23	25,801	61	24
Detroit	228,408	56	18	180,682	55	16	47,726	59	28
Indianapolis	75,007	61	19	55,604	60	16	19,403	63	27
Chicago	325,304	59	17	246,778	59	16	78,526	59	20
Milwaukee	93,146	68	24	73,852	68	21	19,294	70	35
Minneapolis–St. Paul	30,652	57	17	22,891	56	14	7,761	60	25
St. Louis	43,984	68	17	30,623	69	16	13,361	66	19
Kansas City–Tulsa	27,425	60	13	19,211	58	11	8,214	66	17
Dallas–Houston	38,087	45	10	28,036	43	9	10,051	49	13
Denver	20,623	63	11	17,050	62	9	3,573	69	19
Seattle–Portland	15,437	68	18	12,135	67	17	3,302	72	25
San Francisco	27,202	58	16	21,230	58	17	5,972	55	12
Los Angeles	135,297	41	4	109,318	39	4	25,979	46	6
Total	2,217,742	60	18	1,706,984	60	16	510,758	62	23

Machines and People

Some of the most interesting statistics in this report are those on the concentration of machines according to employees and to population (see table on page 17). The leader in 1953, Connecticut, has been displaced by the Boston area as top area in machines per 100 employees, but only by a very close 54.1 to 54.0. The Denver area, with relatively few machine tools but with few metalworking employees, is a close third with 52.9 machines per 100 employees. Lowest area in this category is Seattle–Portland, where there are only 18.2 machines for every 100 employees.

The Bridgeport – Hartford area once again, as in 1953, has the highest concentration of machine tools (62.6) per 1,000 population. Considerably below this figure, but considerably above the remaining areas, is the No. 2 area in this respect –Detroit, with 48.9 machine tools per 1,000 population. The Atlanta–New Orleans area, in 1953 the lowest in this category, once again has the fewest machine tools: 2.8 for every 1,000 population. The reader should recognize that these figures are based upon the 1950 Census; because of the increase in population in most areas since 1950, published figures on machines per 1,000 population may be slightly higher or lower than they actually are today. This is especially true for areas that have had larger gains (or losses) in population than the national average.

Selection of Geographical Areas

The twenty-four areas represented in the new Inventory are the same as those selected for the 1953 report. Each essentially is a geographical entity for which one or two major cities are the chief

INVENTORY BY AREAS

	WELDING EQUIPMENT			HEATING EQUIPMENT			CLEANING AND FINISHING			INDUSTRIAL TRUCKS			OTHER SHOP EQUIPMENT		
	Units	10 yr & over	Over 20 yr	Units	10 yr & over	Over 20 yr	Units	10 yr & over	Over 20 yr	Units	10 yr & over	Over 20 yr	Units	10 yr & over	Over 20 yr
Boston	14,304	48%	12%	7,827	62%	17%	7,391	58%	13%	2,954	35%	5%	4,057	48%	9%
Bridgeport—Hartford	3,769	57	9	4,208	55	15	6,001	47	13	1,679	39	4	2,133	44	7
New York—Newark	21,524	49	6	8,824	52	9	9,292	52	6	4,510	33	1	6,482	44	5
Buffalo—Syracuse	11,481	54	7	4,829	53	13	3,620	43	9	3,921	36	3	2,584	49	12
Philadelphia—Camden	22,545	54	2	5,417	53	12	4,650	59	22	4,527	34	4	2,920	51	8
Pittsburgh—Wheeling	14,471	57	3	5,272	51	13	1,630	46	7	2,693	36	2	2,247	54	12
Baltimore	3,003	64	6	1,428	68	21	985	65	12	2,974	59	15	662	51	1
Richmond	8,015	45	3	2,260	45	9	1,825	40	2	2,266	42	8	1,334	40	5
Atlanta—New Orleans	14,530	42	1	1,982	57	11	1,722	51	12	2,532	35	3	2,183	52	11
Cleveland	14,566	44	8	6,424	54	13	4,204	53	21	4,981	34	3	3,582	50	10
Toledo	3,711	49	3	1,706	44	9	1,438	44	7	1,518	34	2	1,122	40	6
Cincinnati—Louisville	14,580	46	8	3,368	54	12	3,044	48	11	5,354	37	6	2,870	50	11
Detroit	26,699	36	9	9,153	51	16	8,312	46	18	7,822	34	9	5,951	42	10
Indianapolis	6,981	49	6	5,041	56	10	2,414	45	9	2,731	30	3	1,844	44	13
Chicago	44,618	41	4	13,060	50	13	10,673	43	7	12,995	32	3	9,670	51	10
Milwaukee	13,267	40	5	3,756	56	21	2,424	51	11	4,052	37	3	3,044	54	11
Minneapolis—St. Paul	6,222	43	2	1,284	40	7	862	30	5	974	19	1	1,080	49	8
St. Louis	7,096	52	4	1,863	54	10	2,117	27	5	2,335	40	5	1,560	65	12
Kansas City—Tulsa	7,647	47	3	1,112	53	5	811	62	5	1,391	28	1	1,024	46	10
Dallas—Houston	11,013	36	3	1,786	43	16	1,311	28	8	2,824	16	0	1,845	32	4
Denver	3,883	56	4	876	64	14	633	54	13	1,335	56	4	571	48	6
Seattle—Portland	4,689	65	4	646	72	15	483	45	3	562	33	1	527	60	10
San Francisco	7,918	26	1	1,494	54	10	977	35	2	1,367	29	1	890	58	5
Los Angeles	13,179	40	2	5,408	30	1	4,166	31	9	4,598	18	1	4,150	32	2
Total	299,711	45	5	99,024	52	12	80,985	47	11	82,895	34	4	64,332	47	9

markets. For example, the southern section of Illinois is more closely tied to the St. Louis market than to Chicago's. And a city in Western Michigan is likely to direct its attention to what goes on in Chicago rather than in Detroit.

Metalworking tends to concentrate in large cities, or in the outlying districts of those cities. Where these suburban areas are in another state, most people continue to associate them with the city rather than the state. Reports for New York City and Newark, here combined, would be separated in a state-by-state geographic breakdown. So would the numerous and important metalworking cities in Northwestern Indiana and Western Michigan that recognize Chicago as their natural economic leader.

No geographical breakdown will ever satisfy everyone. The present breakdown, chosen five years ago after long consideration, still seems the most acceptable today. And whatever its faults, the fact that it is the same in both Inventories makes comparison of the two reports infinitely easier than with another arrangement.

Analyzing the Area Tables of the Inventory

Detailed breakdowns on 167 machine and equipment types appear for twenty-four areas on pages 37 through 60. It is well to remember that only equipment in use in metalworking plants is included in these pages. Large numbers of machines can be found outside Metalworking — in maintenance shops of non-metalworking industries, in service industries, and in training schools. The tables do not contain, for example, statistics on lathes in plants that make wooden furniture, or on welding equipment used to repair mining machinery. The figures in the tables do, however, represent complete statistics on machinery and equipment in metalworking plants.

Because totals are obtained by expanding actual returns to 100% of a given area, any margin of error is likely to be greater where the return is small. This is especially true for some of the more specialized types of machines which do not exist in large numbers. Conversely, the larger the return, the more accurate the expansion. Average return for all areas, in terms of employees, was 40%. In no area was the return less than 15%.

Employment figures given at the top of each area table are those of the McGraw-Hill Census of Manufacturers, which lists all plants with more than twenty employees. In the preparation of the tables, this employment figure in each area was adjusted in two ways: (1) to include plants with less than twenty employees; (2) to reflect average employment figures in each area during the March—May period when the majority of returns were received. Equipment figures represent 100% of the equipment of 167 types in each area.

HOW THE INVENTORY WAS TAKEN

The first Inventory, taken in 1925, established the basic pattern for succeeding surveys. As Metalworking has grown through the years, so has the Inventory. Refinements have been added, and the scope of the survey has been widened. The current Inventory is no exception to this expansion in coverage.

In March of this year, questionnaires were sent to some 23,000 plants throughout the country—to every metalworking plant listed in the 1958 McGraw-Hill Census of Manufacturers. To insure the greatest possible return, repeat mailings were made in April and May. In addition, to obtain data for a special maintenance survey that appears in the final pages of this 96-page report, questionnaires were sent to several thousand non-metalworking companies, airline and railroad maintenance shops, colleges, vocational institutes, and high schools. Altogether, about 75,000 questionnaires were mailed.

Largest Return Ever

5,560 plants filled out and returned the questionnaires from which the main section of the new Inventory is compiled. In terms of employees, plants with 40% of the wage earners currently in Metalworking are represented. This is a sizeable increase over the 29% return (in terms of employees) of the last Inventory in 1953, and a vital factor in assuring that the Inventory be as accurate as possible.

Here's how the questionnaires were edited when they came in: Each plant was classified (according to its principal product) in one of 44 industries, then put into one of 24 geographical areas. This procedure established, in effect, a grid containing 1,056 cells, each a receptacle for any number of returns. In the final calculations, returns in each cell (including equipment totals for up to 167 types) were expanded to 100% of the plants in the cell. So that such an enormous project could be handled as accurately as possible, calculations for the new Inventory were made for the first time by machine.

Expanding the Cells

The assumption of this Inventory is that, within a given industry, the relationship between wage earners and machines is constant. If the return in industry X is 50%, in terms of employees, and the number of machines reported is 10,000, then it is a reasonable assumption that there are 20,000 machines in Industry X.

This system of expansion was applied to each of the 1,056 cells described above. Shortly before the final calculations, a special run of the McGraw-Hill Census furnished the total number of employees in each cell. A preliminary run of the Inventory gave the actual number, from the questionnaires, of employees in each cell. With these reports, the editors computed 1,056 expansion ratios.

In the final calculations, the expansion ratios were fed by machine into punched cards containing equipment actually reported, and each cell was expanded by the ratio established for the cell. In all but a half-dozen cells, the expansion ratio was less than 10. In no case did the ratio exceed 15.

Where there was no actual return, but the Census reported plants in a cell, the expansion factor was zero. This was true of only a few cells in sparse areas of the country. For this reason, published totals tend to be understated rather than overstated. The editors estimate that published figures average a low, if low at all, of no more than 4½%. Careful study of the cells during the survey, and persistence in seeking actual returns for each weak cell, helped keep this percentage so low.

Because expansion of equipment was by employees in a given industry, it was important that employment figures for each industry be available for the period when the returns were received. To get these statistics, employment figures in the McGraw-Hill Census were adjusted in two ways: (1) to include plants with less than 20 employees, which the Census does not list; (2) to reflect average industry employment during the March–May 1958 period, when the majority of returns came in. The first correction was based on the 1953 U.S. Census of Manufacturers; the second on current reports of the U.S. Bureau of Labor Statistics.

Accuracy of the Inventory

Because this Inventory is the only study of its kind, its accuracy cannot be measured by comparison with other studies. In the past other organizations have made surveys of portions of Metalworking; where a basis for comparison has existed, these smaller surveys have confirmed the accuracy of the AMERICAN MACHINIST Inventories.

The reader should remember that published totals are expansions of actual returns. If no machines of a certain type are reported in an industry for which the return is 50%, it doesn't necessarily mean that the other 50% doesn't have any of the machines. It does mean that the industry doesn't have a significant number of them. There may be 2, or 12, or 15 of these machines in the industry. The likelihood that there will be more is slight.

For this reason the symbol (♦) is used to indicate expanded figures that amount to less than 10. This symbol indicates either that there was no actual return in the industry or that the actual return, expanded, amounts to less than 10.

The greater the percentage of an industry reported, and the greater the number of machines, the lesser the margin of error. If 400 machines in the sample have been expanded to 1,000 machines, the latter figure can be considered fairly accurate (within, say, 50 machines). If 4,000 machines are in the sample, the expanded total should be even more accurate.

Samples in the 44 industries reported range as high as 84%. In no case is the sample less than 10%. In only three industries is the return less than 15%. Average sample for the entire Inventory is 40%.

Farm Machinery

445 plants — 111,873 employees

	Total Units	10 yr & over	Over 20 yr
METAL CUTTING	45,329	72%	26%
METAL FORMING	11,660	72	29
OTHER EQUIPMENT	18,357	54	10
TOTAL	75,346	68	23

Typical Products: Planting, plowing, reaping, spraying, cultivating, harvesting, haying, etc. machinery; farm tractors and conveyors; lawn mowers; balers; poultry equipment (SIC 352)

• – Less than 10

	TOTAL	10-20 YEARS	OVER 20 YR
METAL-CUTTING MACHINES	45,329	20,894	11,791
Boring Machines	1,990	895	502
Horizontal boring, drilling, & milling	758	348	211
Vertical boring mills incl vert turret lathes	268	114	99
Precision, horizontal and vertical	696	326	78
Jig boring, horizontal and vertical	74	48	•
Other (except boring lathes)	194	59	105
Broaching Machines	572	289	96
Horizontal internal or combination	274	153	49
Horizontal surface	72	25	14
Vertical internal	133	50	33
Vertical surface or combination	93	61	•
Continuous horizontal & vertical	•	•	•
Other (incl rotary surface)	•	•	•
Contour Sawing and Filing	283	143	13
Cutoff Machines	2,135	974	223
Bandsaw (incl friction)	750	348	23
Abrasive disk	296	114	19
Hacksaws	913	460	161
Circular (incl friction)	88	29	•
Other	88	23	13
Drilling Machines	12,910	5,685	3,640
Sensitive	1,196	599	239
Upright: Single-spindle	5,300	2,209	1,612
Gang	1,445	751	315
Radial	1,879	848	502
Multi-spindle cluster, adjustable and fixed center	1,101	528	325
Automatic	58	30	•
Unit head & way type (not dial)	825	348	251
Deep-hole drills	82	44	14
Other (not incl special machines)	1,024	328	379
Gear Cutting and Finishing Machines	2,598	992	971
Hobbing machines, gear	1,248	457	515
Shapers, gear	367	165	125
Form-milling type (spur and bevel)	92	32	54
Bevel-gear cutters (not planer)	238	75	128
Grinders, gear tooth	•	•	•
Shavers, gear tooth	265	154	25
Burnishing and lapping	129	45	44
Chamfering, tooth pointing, tooth rounding	131	35	42
Other	124	25	38
Grinding Machines	8,986	4,506	2,120
External cylindrical: Plain	1,025	441	341
Universal	84	51	14
Internal cylindrical	267	136	49
Centerless: External	204	127	36
Internal	50	16	13
Surface: Rotary-table type	283	123	66
Reciprocating type	467	249	57
Disk, horizontal and vertical	330	134	133
Tool and cutter (incl drill)	1,645	759	320
Bench, floorstand, and snag	3,775	2,179	864
Jig grinders	•	•	•
Contour grinders	30	•	•
Abrasive belt (not polishing)	425	202	30
Other (except thread grinders)	400	79	193
Honing and Lapping	520	248	52
Honing: Internal (incl combination)	374	186	25
External and surface	35	•	•
Lapping: Surface	20	18	•
Cylindrical	90	38	26
Other (incl combination hone-lap)	•	•	•
Lathes	8,468	3,903	2,338
Bench, floor, ft-dy (incl turret attachment)	649	363	161
Engine, heavy-duty: Standard	1,540	661	543
Toolroom	607	264	135
Manufacturing and gap	173	102	24
Tracer	41	•	•
Turret lathes: Ram type	1,408	790	315
Saddle type	1,116	559	315
Auto chucking & between centers (single spindle)	1,350	546	401
Automatic chucking (multi-spindle)	436	214	127
Automatic screw machines (single spindle)	348	99	109
Automatic bar machines (multi-spindle)	442	205	73
Other (except spinning lathes)	358	93	135
Milling Machines	3,544	1,639	890
Bench type	60	42	•
Hand	363	168	89
Knee-type: Horizontal (plain & universal)	1,707	781	499
Vertical	468	212	75
Automatic & manufacturing	349	196	33
Ram type, swivel head	45	20	10
Bed (Lincoln) type, incl automatic rise and fall	161	60	64
Planer type (incl skin and spar)	106	18	54
Profilers, duplicators, diesinkers, engravers	52	31	•
Other (except thread milling)	233	111	57
Planers	236	75	152
Double housing	133	40	88
Openside and other	103	35	64
Pipe Cutting and Threading Machines	266	137	37
Polishing and Buffing Machines	837	483	197
Polishing stands (bench and floor)	431	266	135
Speed lathes	133	52	48
Abrasive-belt, disk, drum	225	156	•
Other	48	•	11
Shapers	724	379	267
Horizontal	592	296	243
Vertical, incl slotters & keyseaters	132	83	24
Threading (except pipe)	1,046	464	284
Tapping	642	275	170
Hobbing and milling	56	26	•
Die type	254	123	80
Grinders, thread	15	10	•
Rolling machines, thread	13	•	10
Other	66	30	13

	TOTAL	10-20 YEARS	OVER 20 YR
Electro-Erosion Machines (exc Tap disintegrators)	•	•	•
Ultrasonic Cutting Machines	•	•	•
Special Multi-Station Machines	56	13	•
In-line and transfer	22	•	•
Dial or rotary table	11	•	•
Automatic assembly (all types)	23	•	•
Other Metal-Cutting Machines	153	64	•
METAL-FORMING MACHINES	11,660	5,019	3,337
Bending and Forming Machines (Power)	1,754	808	321
Bending rolls, sheet and plate	515	240	134
Bending rolls, bars and shapes	189	101	59
Bending brakes	756	339	74
Rotary bending and forming machines	72	26	23
Bending machines, pipe, bar, and shapes	222	102	31
Wire and Strip Forming Machines	59	26	•
Hydraulic Presses	1,176	429	256
Vertical, single-action	700	251	151
Vertical, double and triple action	227	102	23
Horizontal	197	66	44
Extrusion (from hot billets)	22	•	16
Other (incl stretch and hydro-pneumatic)	30	•	22
Pneumatic Presses (except hydro-pneumatic)	242	93	44
Mechanical Presses (Power)	4,547	1,955	1,461
Inclinable, single-action (incl inclined)	1,810	881	458
Vertical, single-action: Straight-side (incl arch)	789	409	290
Vertical, single-action: Gap or C-frame	845	316	324
Vertical, single-action: Adjust. bed and horning	284	101	169
Double and triple action	20	10	•
Dieing machines	•	•	•
Horizontal (incl bulldozers)	219	64	79
Multiple transfer (incl eyeletting)	•	•	•
Other	577	171	138
Punching and Shearing Machines	2,167	987	600
Punching machines (incl turret)	556	280	177
Plate and sheet shears	742	272	171
Bar and angle shears	437	189	139
Rotary shears, incl slitters	159	69	44
Nibbling machines	112	51	14
Other	161	46	55
Forging Machinery (except presses)	685	252	400
Hammers, steam or air	64	37	16
Hammers, mechanical (incl drop and helve)	411	137	252
Forging machines (headers) and rolls	168	59	107
Swaging machines	30	16	15
Other	12	•	10
Riveting Machines (not portable)	1,028	549	248
Squeeze type	426	191	99
Rotary-vibrating type	48	27	10
Spinning type	117	69	35
Hammer type	437	262	104
Die Casting Machines	•	•	•
Hot chamber	•	•	•
Cold chamber	•	•	•
Plastics Molding Machines	•	•	•
Injection	•	•	•
Compression	•	•	•
Extrusion	•	•	•
WELDING EQUIPMENT	8,053	3,432	525
Electric Welding Equipment	7,774	3,283	518
Power source: Motor-generator set	2,694	1,342	194
Transformer and rectifier	2,848	1,110	41
Arc-weld machines (not hand) incl automatic	945	234	56
Resistance welders: Spot	986	482	171
Gun (not hand)	90	36	•
Seam	80	36	12
Butt and flash	131	43	44
Gas Welding Machines (not hand)	74	49	•
Flame Cutting Machines (not hand)	205	100	•
HEATING EQUIPMENT	2,951	1,415	533
Heat-treating furnaces	1,058	499	140
Atmosphere generators	81	60	•
Stock-heating furnaces	1,040	529	302
Salt baths	247	121	24
Induction heating units	257	95	•
Baking and drying ovens	219	90	40
Flame-hardening units	69	21	20
CLEANING AND FINISHING	1,423	557	288
Cleaning Equipment	1,321	500	288
Barrel finishing machines	374	138	125
Shot and abrasive blast	408	149	76
Parts washing machines (incl degreasers)	521	205	87
Pickling machines	18	•	•
Plating Equipment	102	57	•
Machines	58	35	•
Barrels	44	22	•
INDUSTRIAL TRUCKS (Power-Driven)	4,180	1,783	220
Lift (rider-type)	2,432	910	217
Truck-tractor	442	223	•
Powered hand trucks	1,174	587	•
Crane trucks	132	63	•
OTHER SHOP EQUIPMENT	1,750	849	259
Balancing Machines	218	80	13
Air Compressors	1,125	586	172
Gear-Checking Machines	407	183	74

Construction, Mining Materials Handling Equipment

Typical Products: Bulldozers, tractors, excavators, road-building equipment, asphalt plants, cranes and derricks; mining cars and machinery, ore crushers, core drills; gas- and water-well machinery; elevators and escalators; conveyors; hoists, industrial cranes; industrial trucks, tractors, and trailers (SIC 353)

903 plants — 257,133 employees

	Total Units	10 yr & over	Over 20 yr
METAL CUTTING	62,496	64%	20%
METAL FORMING	12,103	59	24
OTHER EQUIPMENT	32,843	39	5
TOTAL	107,442	56	16

◆ — Less than 10

	TOTAL	10-20 YEARS	OVER 20 YR
METAL-CUTTING MACHINES	**62,496**	**27,139**	**12,593**
Boring Machines	**3,635**	**1,565**	**954**
Horizontal boring, drilling, & milling	1,291	561	348
Vertical boring mills incl vert turret lathes	1,471	670	491
Precision, horizontal and vertical	616	249	64
Jig boring, horizontal and vertical	200	76	15
Other (except boring lathes)	59	◆	16
Broaching Machines	**457**	**253**	**211**
Horizontal internal or combination	338	114	135
Horizontal surface	176	76	59
Vertical internal	97	54	11
Vertical surface or combination	40	◆	◆
Continuous horizontal & vertical	◆	◆	◆
Other (incl rotary surface)	◆	◆	◆
Contour Sawing and Filing	**518**	**261**	**14**
Cutoff Machines	**3,804**	**1,437**	**382**
Bandsaw (incl friction)	1,362	531	107
Abrasive disk	438	138	28
Hacksaws	1,488	578	191
Circular (incl friction)	437	162	56
Other	79	28	◆
Drilling Machines	**13,563**	**5,841**	**2,772**
Sensitive	1,177	551	116
Upright: Single-spindle	5,378	2,517	1,205
Gang	799	376	156
Radial	4,315	1,721	898
Multi-spindle cluster, adjustable and fixed center	1,268	447	357
Automatic	84	◆	◆
Unit head & way type (not dial)	69	21	◆
Deep-hole drills	163	92	◆
Other (not incl special machines)	310	107	26
Gear Cutting and Finishing Machines	**2,289**	**856**	**663**
Hobbing machines, gear	1,187	448	327
Shapers, gear	527	182	152
Form-milling type (spur and bevel)	204	81	100
Bevel-gear cutters (not planer)	85	37	34
Grinders, gear tooth	22	◆	◆
Shavers, gear tooth	108	53	◆
Burnishing and lapping	◆	◆	◆
Chamfering, tooth pointing, tooth rounding	81	27	20
Other	66	17	21
Grinding Machines	**13,722**	**5,989**	**2,277**
External cylindrical: Plain	1,016	470	218
Universal	416	206	80
Internal cylindrical	528	233	100
Centerless: External	350	109	45
Internal	25	23	◆
Surface: Rotary-table type	446	161	78
Reciprocating type	509	209	62
Disk, horizontal and vertical	321	152	66
Tool and cutter (incl drill)	3,069	1,382	433
Bench, floorstand, and snag	5,397	2,596	1,069
Jig grinders	21	◆	◆
Contour grinders	23	12	◆
Abrasive belt (not polishing)	1,136	317	64
Other (except thread grinders)	465	119	60
Honing and Lapping	**477**	**211**	**33**
Honing: Internal (incl combination)	322	141	25
External and surface	22	◆	◆
Lapping: Surface	36	◆	◆
Cylindrical	57	36	◆
Other (incl combination hone-lap)	40	24	◆
Lathes	**14,105**	**6,848**	**2,746**
Bench, floor, lt-dty (incl turret attachment)	795	412	161
Engine, heavy-duty: Standard	4,018	1,893	1,225
Toolroom	872	392	114
Manufacturing and gap	401	223	48
Tracer	223	49	◆
Turret lathes: Ram type	2,220	1,335	250
Saddle type	2,772	1,489	427
Auto chucking & between centers (single spindle)	1,587	636	369
Automatic chucking (multi-spindle)	362	126	32
Automatic screw machines (single spindle)	234	66	27
Automatic bar machines (multi-spindle)	452	172	48
Other (except spinning lathes)	169	55	43
Milling Machines	**5,230**	**2,106**	**1,241**
Bench type	100	32	20
Hand	316	137	95
Knee-type: Horizontal (plain & universal)	2,369	1,079	446
Vertical	848	328	127
Automatic & manufacturing	184	133	14
Ram type, swivel head	72	30	◆
Bed (Lincoln) type, incl automatic rise and fall	719	203	269
Planer type (incl skin and spar)	251	70	127
Profilers, duplicators, diesinkers, engravers	52	17	◆
Other (except thread milling)	319	77	127
Planers	**564**	**200**	**326**
Double housing	392	131	257
Openside and other	172	69	69
Pipe Cutting and Threading Machines	**746**	**297**	**122**
Polishing and Buffing Machines	**584**	**244**	**72**
Polishing stands (bench and floor)	283	124	55
Speed lathes	68	44	◆
Abrasive-belt, disk, drum	198	58	14
Other	35	18	◆
Shapers	**1,374**	**540**	**534**
Horizontal	983	422	335
Vertical, incl slotters & keyseaters	391	118	199
Threading (except pipe)	**1,054**	**449**	**204**
Tapping	256	96	17
Hobbing and milling	281	149	85
Die type	353	131	82
Grinders, thread	55	38	◆
Rolling machines, thread	13	◆	◆
Other	93	33	12

	TOTAL	10-20 YEARS	OVER 20 YR
Electro-Erosion Machines (exc Tap disintegrators)	20	◆	◆
Ultrasonic Cutting Machines	◆	◆	◆
Special Multi-Station Machines	**49**	**◆**	**◆**
In-line and transfer	2	◆	◆
Dial or rotary table	29	◆	◆
Automatic assembly (all types)	13	◆	◆
Other Metal-Cutting Machines	105	25	39
METAL-FORMING MACHINES	**12,103**	**4,126**	**2,964**
Bending and Forming Machines (Power)	**2,252**	**831**	**523**
Bending rolls, sheet and plate	808	299	281
Bending rolls, bars and shapes	212	88	56
Bending brakes	865	300	110
Rotary bending and forming machines	162	39	57
Bending machines, pipe, bar, and shapes	205	105	19
Wire and Strip Forming Machines	**34**	**◆**	**◆**
Hydraulic Presses	**2,226**	**896**	**367**
Vertical, single-action	1,239	588	182
Vertical, double and triple action	85	30	◆
Horizontal	357	99	122
Extrusion (from hot billets)	◆	◆	◆
Other (incl stretch and hydro-pneumatic)	545	179	63
Pneumatic Presses (except hydro-pneumatic)	**67**	**34**	**16**
Mechanical Presses (Power)	**3,182**	**835**	**707**
Inclinable, single-action (incl inclined)	1,909	420	266
Vertical, single-action: Straight-side (incl arch)	590	168	174
Vertical, single-action: Gap or C-frame	335	157	105
Vertical, single-action: Adjust. bed and horning	47	◆	16
Double and triple action	23	◆	◆
Dieing machines	◆	◆	◆
Horizontal (incl bulldozers)	194	63	98
Multiple transfer (incl eyeletting)	◆	◆	◆
Other	80	11	39
Punching and Shearing Machines	**3,141**	**1,138**	**821**
Punching machines (incl turret)	891	272	332
Plate and sheet shears	965	334	185
Bar and angle shears	615	246	172
Rotary shears, incl slitters	279	132	75
Nibbling machines	292	111	45
Other	99	43	12
Forging Machinery (except presses)	**591**	**129**	**373**
Hammers, steam or air	273	49	191
Hammers, mechanical (incl drop and helve)	158	44	98
Forging machines (headers) and rolls	104	27	59
Swaging machines	23	◆	◆
Other	33	◆	18
Riveting Machines (not portable)	**563**	**225**	**151**
Squeeze type	329	134	95
Rotary-vibrating type	39	19	◆
Spinning type	55	18	19
Hammer type	140	54	33
Die Casting Machines	◆	◆	◆
Hot chamber	◆	◆	◆
Cold chamber	◆	◆	◆
Plastics Molding Machines	**42**	**31**	**◆**
Injection	◆	◆	◆
Compression	36	29	◆
Extrusion	◆	◆	◆
WELDING EQUIPMENT	**20,997**	**7,301**	**615**
Electric Welding Equipment	**19,399**	**6,617**	**548**
Power source: Motor-generator set	7,039	3,497	289
Transformer and rectifier	9,794	2,226	127
Arc-weld machines (not hand) incl automatic	1,807	522	69
Resistance welders: Spot	602	302	60
Gun (not hand)	59	13	◆
Seam	17	◆	◆
Butt and flash	81	48	◆
Gas Welding Machines (not hand)	85	49	◆
Flame Cutting Machines (not hand)	1,513	635	59
HEATING EQUIPMENT	**3,017**	**1,170**	**429**
Heat-treating furnaces	1,505	599	240
Atmosphere generators	150	13	◆
Stock-heating furnaces	444	201	141
Salt baths	202	123	◆
Induction heating units	280	57	11
Baking and drying ovens	264	104	25
Flame-hardening units	172	73	◆
CLEANING AND FINISHING	**1,971**	**767**	**130**
Cleaning Equipment	**1,834**	**734**	**130**
Barrel finishing machines	312	113	51
Shot and abrasive blast	504	236	27
Parts washing machines (incl degreasers)	999	379	52
Pickling machines	19	◆	◆
Plating Equipment	**137**	**33**	**◆**
Machines	76	24	◆
Barrels	61	◆	◆
INDUSTRIAL TRUCKS (Power-Driven)	**4,545**	**1,043**	**126**
Lift (rider-type)	2,691	655	50
Truck-tractor	388	106	12
Powered hand trucks	1,037	161	22
Crane trucks	429	121	42
OTHER SHOP EQUIPMENT	**2,313**	**944**	**250**
Balancing Machines	**228**	**61**	**21**
Air Compressors	**1,841**	**780**	**205**
Gear-Checking Machines	**244**	**103**	**24**

Metalworking Machinery

2103 plants — 317,744 employees

	Total Units	10 yr & over	Over 20 yr
METAL CUTTING	169,304	62%	17%
METAL FORMING	9,580	60	23
OTHER EQUIPMENT	21,944	50	9
TOTAL	200,828	61	16

• – Less than 10

Typical Products: Machine tools, metal forming and metal cutting types; special dies and tools, die sets, jigs, and fixtures; machine-tool accessories and measuring devices; other machine tools (automotive maintenance, power hand tools, metal-marking machines, screw-driving machines, steel-rolling machinery) (SIC 354)

	TOTAL	10-20 YEARS	OVER 20 YR
METAL-CUTTING MACHINES	169,304	76,767	28,837
Boring Machines	8,787	3,389	1,443
Horizontal boring, drilling, & milling	3,879	1,557	691
Vertical boring mills incl vert turret lathes	1,570	611	469
Precision, horizontal and vertical	1,128	414	39
Jig boring, horizontal and vertical	1,954	681	208
Other (except boring lathes)	256	126	36
Broaching Machines	818	402	171
Horizontal internal or combination	482	242	122
Horizontal surface	42	21	•
Vertical internal	150	69	29
Vertical surface or combination	106	57	•
Continuous horizontal & vertical	•	•	•
Other (incl rotary surface)	33	•	•
Contour Sawing and Filing	2,118	862	116
Cutoff Machines	6,125	2,655	553
Bandsaw (incl friction)	2,598	1,052	166
Abrasive disk	898	429	55
Hacksaws	1,946	956	252
Circular (incl friction)	489	163	64
Other	194	55	16
Drilling Machines	25,749	11,660	3,636
Sensitive	4,334	2,022	624
Upright: Single-spindle	11,325	5,130	1,439
Gang	3,004	1,491	431
Radial	5,109	2,357	858
Multi-spindle cluster, adjustable and fixed center	765	277	144
Automatic	247	61	•
Unit head & way type (not dial)	151	50	16
Deep-hole drills	187	54	25
Other (not incl special machines)	627	218	90
Gear Cutting and Finishing Machines	4,545	1,829	1,136
Hobbing machines, gear	1,563	632	408
Shapers, gear	895	419	211
Form-milling type (spur and bevel)	231	51	155
Bevel-gear cutters (not planer)	317	104	114
Grinders, gear tooth	838	373	112
Shavers, gear tooth	243	95	•
Burnishing and lapping	112	40	16
Chamfering, tooth pointing, tooth rounding	130	49	38
Other	216	66	79
Grinding Machines	48,378	22,561	8,515
External cylindrical: Plain	4,613	2,638	764
Universal	2,804	1,411	463
Internal cylindrical	3,141	1,763	558
Centerless: External	885	511	27
Internal	149	102	•
Surface: Rotary-table type	2,585	1,158	367
Reciprocating type	9,601	4,404	1,052
Disk, horizontal and vertical	864	379	174
Tool and cutter (incl drill)	10,548	4,080	3,297
Bench, floorstand, and snag	8,439	4,131	1,434
Jig grinders	429	84	•
Contour grinders	758	309	37
Abrasive belt (not polishing)	1,584	646	61
Other (except thread grinders)	1,978	945	272
Honing and Lapping	3,020	1,313	266
Honing: Internal (incl combination)	1,518	618	63
External and surface	58	10	•
Lapping: Surface	505	230	67
Cylindrical	415	133	61
Other (incl combination hone-lap)	524	322	73
Lathes	29,257	14,004	5,475
Bench, floor, ft-dy (incl turret attachment)	4,571	2,171	715
Engine, heavy-duty: Standard	7,242	3,553	1,983
Toolroom	4,903	2,240	705
Manufacturing and gap	650	251	223
Tracer	488	80	•
Turret lathes: Ram type	3,596	1,904	372
Saddle type	3,348	1,883	444
Auto chucking & between centers (single spindle)	603	237	64
Automatic chucking (multi-spindle)	142	88	10
Automatic screw machines (single spindle)	1,924	896	370
Automatic bar machines (multi-spindle)	769	428	81
Other (except spinning lathes)	1,021	273	504
Milling Machines	23,848	10,383	3,918
Bench type	450	161	42
Hand	1,757	816	307
Knee-type: Horizontal (plain & universal)	9,195	4,405	2,156
Vertical	6,189	2,508	506
Automatic & manufacturing	928	587	59
Ram type, swivel head	732	175	10
Bed (Lincoln) type, incl automatic rise and fall	1,000	535	72
Planer type (incl skin and spar)	499	181	104
Profilers, duplicators, diesinkers, engravers	1,672	606	159
Other (except thread milling)	1,426	409	503
Planers	2,522	1,025	929
Double housing	1,792	801	733
Openside and other	730	224	196
Pipe Cutting and Threading Machines	650	254	75
Polishing and Buffing Machines	4,397	1,973	647
Polishing stands (bench and floor)	1,577	775	226
Speed lathes	1,346	619	307
Abrasive-belt, disk, drum	1,327	556	100
Other	147	23	14
Shapers	4,477	2,128	1,132
Horizontal	3,631	1,724	885
Vertical, incl slotters & keyseaters	846	404	247
Threading (except pipe)	3,572	1,907	621
Tapping	607	216	57
Hobbing and milling	1,107	530	367
Die type	179	81	44
Grinders, thread	1,448	985	111
Rolling machines, thread	116	46	14
Other	115	49	28

	TOTAL	10-20 YEARS	OVER 20 YR
Electro-Erosion Machines (exc Tap disintegrators)	112	18	•
Ultrasonic Cutting Machines	29	•	•
Special Multi-Station Machines	100	37	•
In-line and transfer	•	•	•
Dial or rotary table	86	33	•
Automatic assembly (all types)	11	•	•
Other Metal-Cutting Machines	800	365	202
METAL-FORMING MACHINES	9,580	3,578	2,216
Bending and Forming Machines (Power)	1,289	446	250
Bending rolls, sheet and plate	323	103	108
Bending rolls, bars and shapes	108	45	21
Bending brakes	525	183	73
Rotary bending and forming machines	112	34	10
Bending machines, pipe, bar, and shapes	221	81	38
Wire and Strip Forming Machines	83	•	•
Hydraulic Presses	1,531	642	208
Vertical, single-action	1,229	540	123
Vertical, double and triple action	72	26	•
Horizontal	73	18	30
Extrusion (from hot billets)	•	•	•
Other (incl stretch and hydro-pneumatic)	157	58	48
Pneumatic Presses (except hydro-pneumatic)	92	44	•
Mechanical Presses (Power)	4,315	1,684	1,113
Inclinable, single-action (incl inclined)	2,289	940	471
Vertical, single-action: Straight-side (incl arch)	836	307	208
Vertical, single-action: Gap or C-frame	492	196	152
Vertical, single-action: Adjust. bed and horning	58	18	21
Double and triple action	205	98	52
Dieing machines	70	22	14
Horizontal (incl bulldozers)	18	•	12
Multiple transfer (incl eyeletting)	27	21	•
Other	320	80	183
Punching and Shearing Machines	1,256	416	304
Punching machines (incl turret)	272	75	70
Plate and sheet shears	537	195	139
Bar and angle shears	73	18	30
Rotary shears, incl slitters	80	32	16
Nibbling machines	197	71	10
Other	97	25	39
Forging Machinery (except presses)	315	95	171
Hammers, steam or air	114	35	67
Hammers, mechanical (incl drop and helve)	79	11	59
Forging machines (headers) and rolls	30	•	15
Swaging machines	56	23	20
Other	36	19	10
Riveting Machines (not portable)	377	128	40
Squeeze type	150	40	•
Rotary-vibrating type	65	30	•
Spinning type	56	18	•
Hammer type	106	40	17
Die Casting Machines	22	•	10
Hot chamber	•	•	•
Cold chamber			
Plastics Molding Machines	300	108	114
Injection	102	47	•
Compression	198	61	114
Extrusion	•	•	•
WELDING EQUIPMENT	5,411	2,138	359
Electric Welding Equipment	4,783	1,910	317
Power source: Motor-generator set	1,631	800	120
Transformer and rectifier	1,484	476	40
Arc-weld machines (not hand) incl automatic	785	326	38
Resistance welders: Spot	659	234	79
Gun (not hand)	20	•	•
Seam	26	•	•
Butt and flash	178	58	38
Gas Welding Machines (not hand)	173	65	•
Flame Cutting Machines (not hand)	455	163	39
HEATING EQUIPMENT	6,617	3,266	892
Heat-treating furnaces	4,146	2,278	682
Atmosphere generators	235	78	•
Stock-heating furnaces	208	74	41
Salt baths	1,001	454	67
Induction heating units	442	158	•
Baking and drying ovens	379	116	78
Flame-hardening units	206	108	14
CLEANING AND FINISHING	2,641	921	175
Cleaning Equipment	2,321	779	160
Barrel finishing machines	697	180	54
Shot and abrasive blast	814	313	91
Parts washing machines (incl degreasers)	791	283	15
Pickling machines	19	•	•
Plating Equipment	320	142	15
Machines	252	122	•
Barrels	68	20	12
INDUSTRIAL TRUCKS (Power-Driven)	2,893	960	70
Lift (rider-type)	1,841	590	21
Truck-tractor	287	120	22
Powered hand trucks	600	190	19
Crane trucks	165	60	•
OTHER SHOP EQUIPMENT	4,382	1,735	404
Balancing Machines	312	112	31
Air Compressors	2,899	1,140	201
Gear-Checking Machines	1,171	483	172

Special-Industry Machinery

Typical Products: Food products, textile, woodworking, paper industries, printing trades, chemical, cotton ginning, cigarette making, rubber products, and shoemaking machinery; smelting and refining equipment (SIC 355)

1110 plants — 168,164 employees

	Total Units	10 yr & over	Over 20 yr
METAL CUTTING	81,472	71%	24%
METAL FORMING	9,801	69	31
OTHER EQUIPMENT	17,292	51	9
TOTAL	108,565	68	22

• – Less than 10

	TOTAL	10-20 YEARS	OVER 20 YR
METAL-CUTTING MACHINES	81,472	38,467	19,516
Boring Machines	3,885	1,630	1,064
Horizontal boring, drilling, & milling	1,551	648	395
Vertical boring mills incl vert turret lathes	1,410	622	583
Precision, horizontal and vertical	354	123	21
Jig boring, horizontal and vertical	415	197	53
Other (except boring lathes)	155	40	12
Broaching Machines	469	210	172
Horizontal internal or combination	272	125	100
Horizontal surface	20	12	•
Vertical internal	126	53	56
Vertical surface or combination	25	17	•
Continuous horizontal & vertical	21	•	11
Other (incl rotary surface)	•	•	•
Contour Sawing and Filing	851	392	53
Cutoff Machines	4,152	1,791	997
Bandsaw (incl friction)	1,585	786	144
Abrasive disk	652	167	75
Hacksaws	1,466	696	262
Circular (incl friction)	357	116	95
Other	92	26	21
Drilling Machines	16,647	8,542	3,276
Sensitive	2,533	1,306	331
Upright: Single-spindle	1,058	3,530	1,440
Gang	2,749	1,530	563
Radial	2,938	1,436	696
Multi-spindle cluster, adjustable and fixed center	734	378	157
Automatic	101	35	•
Unit head & way type (not dial)	34	17	•
Deep-hole drills	55	17	13
Other (not incl special machines)	445	293	69
Gear Cutting and Finishing Machines	1,882	810	732
Hobbing machines, gear	742	320	291
Shapers, gear	587	307	206
Form-milling type (spur and bevel)	231	82	117
Bevel-gear cutters (not planer)	157	65	58
Grinders, gear tooth	34	10	•
Shavers, gear tooth	32	11	•
Burnishing and lapping	34	•	23
Chamfering, tooth pointing, tooth rounding	26	•	•
Other	39	•	30
Grinding Machines	15,626	8,161	2,700
External cylindrical: Plain	1,432	745	421
Universal	498	238	95
Internal cylindrical	405	250	71
Centerless: External	209	112	51
Internal	22	18	•
Surface: Rotary-table type	631	324	142
Reciprocating type	1,725	914	227
Disk, horizontal and vertical	530	294	97
Tool and cutter (incl drill)	3,124	1,664	501
Bench, floorstand, and snag	5,313	2,821	965
Jig grinders	36	22	•
Contour grinders	73	13	•
Abrasive belt (not polishing)	1,330	648	42
Other (except thread grinders)	298	98	82
Honing and Lapping	527	229	18
Honing: Internal (incl combination)	383	162	15
External and surface	31	29	•
Lapping: Surface	64	13	•
Cylindrical	32	15	•
Other (incl combination hone-lap)	17	10	•
Lathes	17,856	8,370	5,184
Bench, floor, ft-dy (incl turret attachment)	2,926	1,247	1,084
Engine, heavy-duty: Standard	6,512	2,790	2,249
Toolroom	1,618	738	438
Manufacturing and gap	292	104	81
Tracer	225	38	•
Turret lathes: Ram type	2,890	1,726	436
Saddle type	1,569	1,070	168
Auto chucking & between centers (single spindle)	515	213	203
Automatic chucking (multi-spindle)	161	44	91
Automatic screw machines (single spindle)	706	228	218
Automatic bar machines (multi-spindle)	197	116	45
Other (except spinning lathes)	245	56	171
Milling Machines	10,715	4,831	2,760
Bench type	323	127	80
Hand	824	341	352
Knee-type: Horizontal (plain & universal)	4,817	2,162	1,364
Vertical	2,249	1,071	298
Automatic & manufacturing	517	380	52
Ram type, swivel head	308	111	10
Bed (Lincoln) type, incl automatic rise and fall	563	296	147
Planer type (incl skin and spar)	354	91	175
Profilers, duplicators, diesinkers, engravers	426	146	142
Other (except thread milling)	334	106	149
Planers	1,677	489	968
Double housing	1,221	333	792
Openside and other	456	156	176
Pipe Cutting and Threading Machines	650	284	114
Polishing and Buffing Machines	3,644	1,624	713
Polishing stands (bench and floor)	1,483	810	270
Speed lathes	972	358	349
Abrasive-belt, disk, drum	952	378	76
Other	237	78	18
Shapers	1,869	727	864
Horizontal	1,397	534	675
Vertical, incl slotters & keyseaters	472	193	189
Threading (except pipe)	737	294	224
Tapping	353	174	66
Hobbing and milling	164	66	66
Die type	130	23	63
Grinders, thread	25	12	•
Rolling machines, thread	41	14	•
Other	24	•	19

	TOTAL	10-20 YEARS	OVER 20 YR
Electro-Erosion Machines (exc Tap disintegrators)	26	•	•
Ultrasonic Cutting Machines	•	•	•
Special Multi-Station Machines	47	19	•
In-line and transfer	33	19	•
Dial or rotary table	14	•	•
Automatic assembly (all types)	28	14	•
Other Metal-Cutting Machines	208	60	71
METAL-FORMING MACHINES	9,801	3,753	3,001
Bending and Forming Machines (Power)	2,551	1,098	614
Bending rolls, sheet and plate	896	412	264
Bending rolls, bars and shapes	297	158	73
Bending brakes	943	367	221
Rotary bending and forming machines	124	39	22
Bending machines, pipe, bar, and shapes	291	122	34
Wire and Strip Forming Machines	239	68	136
Hydraulic Presses	998	383	218
Vertical, single-action	737	293	151
Vertical, double and triple action	51	21	•
Horizontal	177	69	65
Extrusion (from hot billets)	•	•	•
Other (incl stretch and hydro-pneumatic)	33	•	•
Pneumatic Presses (except hydro-pneumatic)	116	44	18
Mechanical Presses (Power)	2,617	936	957
Inclinable, single-action (incl inclined)	1,617	544	583
Vertical, single-action: Straight-side (incl arch)	325	138	123
Vertical, single-action: Gap or C-frame	342	133	146
Vertical, single-action: Adjust. bed and horning	67	37	24
Double and triple action	57	•	26
Dieing machines	21	•	•
Horizontal (incl bulldozers)	44	•	15
Multiple transfer (incl eyeletting)	•	•	•
Other	144	65	31
Punching and Shearing Machines	2,248	860	729
Punching machines (incl turret)	628	233	312
Plate and sheet shears	767	295	196
Bar and angle shears	251	96	71
Rotary shears, incl slitters	197	95	65
Nibbling machines	315	122	58
Other	90	19	27
Forging Machinery (except presses)	502	156	199
Hammers, steam or air	94	49	40
Hammers, mechanical (incl drop and helve)	161	48	99
Forging machines (headers) and rolls	26	•	10
Swaging machines	58	14	30
Other	163	39	20
Riveting Machines (not portable)	294	102	126
Squeeze type	134	57	10
Rotary-vibrating type	145	33	62
Spinning type	106	50	29
Hammer type	111	56	19
Die Casting Machines	21	11	10
Hot chamber	11	11	•
Cold chamber	10	•	10
Plastics Molding Machines	13	•	•
Injection	•	•	•
Compression	•	•	•
Extrusion	•	•	•
WELDING EQUIPMENT	8,324	3,656	380
Electric Welding Equipment	7,593	3,329	349
Power source: Motor-generator set	3,808	1,879	153
Transformer and rectifier	1,868	565	•
Arc-weld machines (not hand) incl automatic	809	347	13
Resistance welders: Spot	849	399	131
Gun (not hand)	69	51	•
Seam	61	•	24
Butt and flash	129	79	20
Gas Welding Machines (not hand)	201	96	•
Flame Cutting Machines (not hand)	530	231	22
HEATING EQUIPMENT	2,405	1,164	376
Heat-treating furnaces	1,377	701	260
Atmosphere generators	62	32	•
Stock-heating furnaces	211	102	70
Salt baths	331	184	14
Induction heating units	116	35	•
Baking and drying ovens	213	68	19
Flame-hardening units	95	42	10
CLEANING AND FINISHING	1,848	585	343
Cleaning Equipment	1,520	441	232
Barrel finishing machines	766	163	176
Shot and abrasive blast	332	129	25
Parts washing machines (incl degreasers)	394	135	31
Pickling machines	28	14	•
Plating Equipment	328	144	111
Machines	262	125	68
Barrels	66	19	43
INDUSTRIAL TRUCKS (Power-Driven)	2,103	663	187
Lift (rider-type)	1,181	381	48
Truck-tractor	282	52	38
Powered hand trucks	473	172	10
Crane trucks	167	58	11
OTHER SHOP EQUIPMENT	2,612	1,176	289
Balancing Machines	449	159	63
Air Compressors	2,009	959	199
Gear-Checking Machines	154	58	27

General Industrial Equipment

1329 plants — 374,094 employees

	Total Units	10 yr & over	Over 20 yr
METAL CUTTING	145,926	66%	18%
METAL FORMING	14,686	70	29
OTHER EQUIPMENT	32,922	47	9
TOTAL	193,534	65	16

• – Less than 10

Typical Products: Steam engines; steam, gas, and hydraulic turbines and turbine generator sets; internal combustion engines; pumps and compressors; ball and roller bearings; blowers and ventilating fans; industrial patterns; mechanical power-transmission equipment; industrial furnaces and ovens; fire-fighting apparatus; lubrication equipment (SIC 351, 356)

	TOTAL	10-20 YEARS	OVER 20 YR
METAL-CUTTING MACHINES	145,926	70,553	26,420
Boring Machines	6,863	3,328	1,398
Horizontal boring, drilling, & milling	1,904	861	427
Vertical boring mills incl vert turret lathes	2,443	1,188	711
Precision, horizontal and vertical	1,763	950	95
Jig boring, horizontal and vertical	519	230	71
Other (except boring lathes)	234	99	94
Broaching Machines	1,530	774	357
Horizontal internal or combination	837	426	237
Horizontal surface	110	68	18
Vertical internal	302	147	64
Vertical surface or combination	239	119	36
Continuous horizontal & vertical	•	•	•
Other (incl rotary surface)	34	14	•
Contour Sawing and Filing	556	239	35
Cutoff Machines	5,145	2,294	597
Bandsaw (incl friction)	1,718	747	117
Abrasive disk	687	295	44
Hacksaws	1,867	918	259
Circular (incl friction)	549	192	102
Other	324	142	75
Drilling Machines	25,827	12,775	4,878
Sensitive	3,847	1,850	913
Upright: Single-spindle	9,804	4,900	1,739
Gang	3,634	1,986	512
Radial	4,254	2,190	879
Multi-spindle cluster, adjustable and fixed center	2,104	914	491
Automatic	603	259	45
Unit head & way type (not dial)	285	87	28
Deep-hole drills	304	196	48
Other (not incl special machines)	992	593	223
Gear Cutting and Finishing Machines	9,936	5,014	2,086
Hobbing machines, gear	4,317	2,132	961
Shapers, gear	2,199	1,311	231
Form-milling type (spur and bevel)	700	160	469
Bevel-gear cutters (not planer)	978	548	149
Grinders, gear tooth	486	283	39
Shavers, gear tooth	502	243	15
Burnishing and lapping	255	121	74
Chamfering, tooth pointing, tooth rounding	166	82	38
Other	333	134	130
Grinding Machines	36,228	17,392	6,321
External cylindrical: Plain	3,958	2,133	672
Universal	1,147	601	176
Internal cylindrical	3,012	1,519	453
Centerless: External	2,320	1,033	361
Internal	1,473	621	295
Surface: Rotary-table type	2,058	1,137	293
Reciprocating type	1,932	1,007	270
Disk, horizontal and vertical	1,200	525	252
Tool and cutter (incl drill)	6,380	3,089	1,179
Bench, floorstand, and snag	6,019	3,288	872
Jig grinders	42	21	•
Contour grinders	426	237	33
Abrasive belt (not polishing)	1,014	388	83
Other (except thread grinders)	5,247	1,793	1,382
Honing and Lapping	3,867	1,668	381
Honing: Internal (incl combination)	1,502	479	100
External and surface	177	85	•
Lapping: Surface	1,361	757	167
Cylindrical	459	188	110
Other (incl combination hone-lap)	368	159	•
Lathes	33,123	16,111	5,930
Bench, floor, ft-dy (incl turret attachment)	3,305	1,630	561
Engine, heavy-duty: Standard	6,430	3,037	1,962
Toolroom	2,528	1,164	355
Manufacturing and gap	975	452	284
Tracer	585	81	•
Turret lathes: Ram type	5,951	3,363	720
Saddle type	4,030	2,285	677
Auto chucking & between centers (single spindle)	2,242	986	274
Automatic chucking (multi-spindle)	1,334	553	173
Automatic screw machines (single spindle)	3,809	1,723	770
Automatic bar machines (multi-spindle)	1,249	560	51
Other (except spinning lathes)	685	277	97
Milling Machines	11,226	5,534	2,031
Bench type	353	145	34
Hand	1,349	644	344
Knee-type: Horizontal (plain & universal)	4,449	2,203	956
Vertical	2,063	1,004	199
Automatic & manufacturing	785	425	141
Ram type, swivel head	308	117	11
Bed (L.Incoln) type, incl automatic rise and fall	748	403	137
Planer type (incl skin and spar)	359	216	98
Profilers, duplicators, diesinkers, engravers	276	90	34
Other (except thread milling)	536	287	77
Planers	568	166	360
Double housing	360	108	240
Openside and other	208	60	120
Pipe Cutting and Threading Machines	968	435	116
Polishing and Buffing Machines	4,199	2,092	509
Polishing stands (bench and floor)	1,732	820	211
Speed lathes	1,440	894	176
Abrasive-belt, disk, drum	843	326	47
Other	184	52	75
Shapers	2,038	814	832
Horizontal	1,362	534	550
Vertical, incl slotters & keyseaters	673	280	282
Threading (except pipe)	2,905	1,582	389
Tapping	1,105	551	95
Hobbing and milling	848	502	182
Die type	176	85	45
Grinders, thread	630	401	49
Rolling machines, thread	115	39	18
Other	31	•	•

	TOTAL	10-20 YEARS	OVER 20 YR
Electro-Erosion Machines (exc Tap disintegrators)	34	•	•
Ultrasonic Cutting Machines	•	•	•
Special Multi-Station Machines	332	61	42
In-line and transfer	81	•	•
Dial or rotary table	189	31	40
Automatic assembly (all types)	62	23	•
Other Metal-Cutting Machines	575	263	158
METAL-FORMING MACHINES	14,686	5,932	4,284
Bending and Forming Machines (Power)	2,241	887	576
Bending rolls, sheet and plate	789	353	242
Bending rolls, bars and shapes	224	99	33
Bending brakes	798	280	206
Rotary bending and forming machines	124	47	54
Bending machines, pipe, bar, and shapes	306	108	41
Wire and Strip Forming Machines	228	105	42
Hydraulic Presses	1,917	829	333
Vertical, single-action	1,449	643	202
Vertical, double and triple action	202	95	36
Horizontal	135	40	63
Extrusion (from hot billets)	15	•	10
Other (incl stretch and hydro-pneumatic)	116	49	22
Pneumatic Presses (except hydro-pneumatic)	361	167	30
Mechanical Presses (Power)	6,149	2,257	2,284
Inclinable, single-action (incl inclined)	2,377	895	733
Vertical, Straight-side (incl arch)	1,434	420	652
Vertical, Gap or C-frame	1,138	309	658
single-action Adjust; bed and horning	67	29	32
Double and triple action	64	18	21
Dieing machines	11	•	•
Horizontal (incl bulldozers)	51	12	39
Multiple transfer (incl eyeletting)	19	12	•
Other	988	553	147
Punching and Shearing Machines	2,098	884	626
Punching machines (incl turret)	498	233	188
Plate and sheet shears	784	355	192
Bar and angle shears	217	81	65
Rotary shears, incl slitters	295	108	112
Nibbling machines	258	102	63
Other	46	•	•
Forging Machinery (except presses)	600	259	205
Hammers, steam or air	72	14	47
Hammers, mechanical (incl drop and helve)	154	37	81
Forging machines (headers) and rolls	294	188	51
Swaging machines	59	14	18
Other	21	•	•
Riveting Machines (not portable)	1,033	518	188
Squeeze type	378	190	46
Rotary-vibrating type	127	66	40
Spinning type	88	28	11
Hammer type	440	234	91
Die Casting Machines	36	•	•
Hot chamber	17	•	•
Cold chamber	19	•	•
Plastics Molding Machines	23	20	•
Injection	10	10	•
Compression	13	10	•
Extrusion	•	•	•
WELDING EQUIPMENT	11,330	4,465	836
Electric Welding Equipment	10,576	4,121	793
Power source: Motor-generator set	3,553	1,904	437
Transformer and rectifier	4,558	1,218	80
Arc-weld machines (not hand) incl automatic	931	344	38
Resistance welders: Spot	1,234	492	210
Gun (not hand)	77	28	15
Seam	54	27	•
Butt and flash	169	108	13
Gas Welding Machines (not hand)	128	86	•
Flame Cutting Machines (not hand)	626	258	41
HEATING EQUIPMENT	7,055	2,811	998
Heat-treating furnaces	3,745	1,697	650
Atmosphere generators	449	143	•
Stock-heating furnaces	670	269	133
Salt baths	467	210	82
Induction heating units	867	161	35
Baking and drying ovens	717	288	94
Flame-hardening units	140	43	•
CLEANING AND FINISHING	5,111	1,907	526
Cleaning Equipment	4,820	1,808	499
Barrel finishing machines	1,908	707	255
Shot and abrasive blast	870	369	82
Parts washing machines (incl degreasers)	1,983	705	157
Pickling machines	59	27	•
Plating Equipment	291	99	27
Machines	224	65	27
Barrels	67	34	•
INDUSTRIAL TRUCKS (Power-Driven)	4,256	1,267	40
Lift (rider-type)	2,576	733	20
Truck-tractor	411	106	•
Powered hand trucks	1,111	362	•
Crane trucks	157	66	11
OTHER SHOP EQUIPMENT	5,245	2,159	477
Balancing Machines	899	354	70
Air Compressors	2,649	1,186	233
Gear-Checking Machines	1,697	619	174

Fabricated Metal Products

Typical Products: Metal cans; cutlery; hand tools; hardware; enameled iron ware; plumbing fittings; heating equipment, except electric; fabricated structural steel, fabricated plate work; sheet-metal work; screw-machine products; bolts, nuts, rivets; metal stampings; electroplating; coating and engraving; fabricated wire products; safes and vaults; steel springs; valves; fabricated pipe (SIC 34)

7393 plants — 1,108,400 employees

	Total Units	10 yr & over	Over 20 yr
METAL CUTTING	326,317	59%	16%
METAL FORMING	191,543	65	25
OTHER EQUIPMENT	186,588	49	7
TOTAL	704,448	58	16

◆ – Less than 10

	TOTAL	10-20 YEARS	OVER 20 YR
METAL-CUTTING MACHINES	326,317	139,901	52,220
Boring Machines	6,044	2,657	1,562
Horizontal boring, drilling, & milling	2,105	955	553
Vertical boring mills incl vert turret lathes	2,717	1,227	931
Precision, horizontal and vertical	497	234	36
Jig boring, horizontal and vertical	530	175	17
Other (except boring lathes)	195	66	25
Broaching Machines	1,750	782	213
Horizontal internal or combination	431	257	42
Horizontal surface	172	57	◆
Vertical internal	633	209	103
Vertical surface or combination	425	230	33
Continuous horizontal & vertical	14	◆	◆
Other (incl rotary surface)	75	23	30
Contour Sawing and Filing	3,096	1,834	227
Cutoff Machines	26,498	10,863	2,194
Bandsaw (incl friction)	10,298	4,167	555
Abrasive disk	3,493	1,198	105
Hacksaws	7,006	3,556	1,013
Circular (incl friction)	4,171	1,433	400
Other	1,450	509	121
Drilling Machines	70,566	30,215	10,160
Sensitive	7,210	2,714	494
Upright: Single-spindle	41,945	18,522	6,053
Gang	4,773	2,012	768
Radial	6,627	3,093	1,475
Multi-spindle cluster, adjustable and fixed center	3,737	1,562	539
Automatic	1,721	322	211
Unit head & way type (not dial)	656	233	108
Deep-hole drills	311	69	35
Other (not incl special machines)	3,586	1,688	477
Gear Cutting and Finishing Machines	1,181	427	358
Hobbing machines, gear	415	128	185
Shapers, gear	399	187	108
Form-milling type (spur and bevel)	68	◆	◆
Bevel-gear cutters (not planer)	23	11	◆
Grinders, gear tooth	26	◆	15
Shavers, gear tooth	41	◆	21
Burnishing and lapping	99	22	◆
Chamfering, tooth pointing, tooth rounding	66	56	◆
Other	44	14	20
Grinding Machines	60,851	27,182	7,966
External cylindrical: Plain	2,406	1,264	460
Universal	1,396	710	147
Internal cylindrical	922	524	127
Centerless: External	1,719	964	65
Internal	139	81	17
Surface: Rotary-table type	2,425	1,006	355
Reciprocating type	7,042	3,289	762
Disk, horizontal and vertical	3,063	1,214	415
Tool and cutter (incl drill)	8,722	4,064	1,122
Bench, floorstand, and snag	23,644	11,281	2,806
Jig grinders	411	110	84
Contour grinders	532	188	102
Abrasive belt (not polishing)	4,821	1,765	145
Other (except thread grinders)	3,609	722	1,359
Honing and Lapping	1,519	585	25
Honing: Internal (incl combination)	1,011	405	17
External and surface	82	40	◆
Lapping: Surface	238	52	◆
Cylindrical	76	39	◆
Other (incl combination hone-lap)	112	19	◆
Lathes	71,839	32,937	12,950
Bench, floor, ft-dy (incl turret attachment)	9,654	4,580	1,481
Engine, heavy-duty: Standard	11,332	4,717	3,804
Toolroom	9,398	4,211	1,691
Manufacturing and gap	1,070	307	453
Tracer	343	50	24
Turret lathes: Ram type	8,680	4,818	1,234
Saddle type	3,937	2,283	594
Auto chucking & between centers (single spindle)	808	340	18
Automatic chucking (multi-spindle)	1,675	782	289
Automatic screw machines (single spindle)	13,785	5,354	1,794
Automatic bar machines (multi-spindle)	10,025	5,144	1,022
Other (except spinning lathes)	1,132	351	546
Milling Machines	23,997	10,895	4,643
Bench type	1,975	952	182
Hand	4,476	2,195	964
Knee-type: Horizontal (plain & universal)	8,326	3,842	2,121
Vertical	4,286	1,651	422
Automatic & manufacturing	1,741	976	163
Ram type, swivel head	676	232	47
Bed (Lincoln) type, incl automatic rise and fall	642	320	179
Planer type (incl skin and spar)	460	233	149
Profilers, duplicators, diesinkers, engravers	731	226	220
Other (except thread milling)	662	268	216
Planers	2,431	761	1,460
Double housing	1,609	496	1,037
Openside and other	822	265	423
Pipe Cutting and Threading Machines	5,417	2,049	784
Polishing and Buffing Machines	23,013	8,276	2,475
Polishing stands (bench and floor)	12,186	4,108	1,564
Speed lathes	2,309	815	479
Abrasive-belt, disk, drum	5,598	2,312	260
Other	2,920	1,041	172
Shapers	8,681	3,592	3,022
Horizontal	7,777	3,171	2,746
Vertical, incl slotters & keyseaters	904	421	276
Threading (except pipe)	14,765	5,736	3,108
Tapping	6,105	2,562	768
Hobbing and milling	421	256	67
Die type	2,363	891	828
Grinders, thread	475	352	35
Rolling machines, thread	3,921	1,108	1,057
Other	1,480	567	353

	TOTAL	10-20 YEARS	OVER 20 YR
Electro-Erosion Machines (exc Tap disintegrators)	74	◆	◆
Ultrasonic Cutting Machines	◆	◆	◆
Special Multi-Station Machines	2,077	577	497
In-line and transfer	330	40	48
Dial or rotary table	1,166	249	324
Automatic assembly (all types)	581	288	125
Other Metal-Cutting Machines	1,712	557	556
METAL-FORMING MACHINES	191,543	76,437	48,848
Bending and Forming Machines (Power)	26,044	10,572	3,947
Bending rolls, sheet and plate	7,888	3,538	1,722
Bending rolls, bars and shapes	2,139	904	328
Bending brakes	10,425	4,011	1,176
Rotary bending and forming machines	2,076	653	268
Bending machines, pipe, bar, and shapes	3,516	1,466	453
Wire and Strip Forming Machines	10,913	3,787	3,031
Hydraulic Presses	5,702	2,294	732
Vertical, single-action	3,965	1,741	480
Vertical, double and triple action	532	241	82
Horizontal	673	239	122
Extrusion (from hot billets)	124	◆	17
Other (incl stretch and hydro-pneumatic)	408	69	31
Pneumatic Presses (except hydro-pneumatic)	1,008	476	54
Mechanical Presses (Power)	97,711	39,616	28,236
Inclinable, single-action (incl inclined)	56,199	23,920	12,836
Vertical, single-action: Straight-side (incl arch)	14,067	5,445	6,199
Vertical, single-action: Gap or C-frame	13,790	4,991	4,274
Vertical, single-action: Adjust. bed and horning	4,108	1,778	1,386
Double and triple action	2,237	1,070	616
Dieing machines	646	199	99
Horizontal (incl bulldozers)	826	204	377
Multiple transfer (incl eyeletting)	960	382	97
Other	4,878	1,627	2,352
Punching and Shearing Machines	28,790	11,545	7,454
Punching machines (incl turret)	9,366	3,150	2,927
Plate and sheet shears	9,196	4,107	1,940
Bar and angle shears	3,624	1,512	1,060
Rotary shears, incl slitters	3,146	1,251	1,168
Nibbling machines	2,225	1,026	250
Other	1,233	499	309
Forging Machinery (except presses)	8,290	3,205	3,396
Hammers, steam or air	604	216	330
Hammers, mechanical (incl drop and helve)	2,120	615	1,339
Forging machines (headers) and rolls	3,677	1,555	1,183
Swaging machines	1,326	698	359
Other	563	121	185
Riveting Machines (not portable)	11,753	4,340	1,728
Squeeze type	5,558	2,119	884
Rotary-vibrating type	1,514	456	228
Spinning type	1,151	500	227
Hammer type	3,530	1,265	389
Die Casting Machines	680	279	27
Hot chamber	655	269	27
Cold chamber	25	10	◆
Plastics Molding Machines	652	323	43
Injection	316	132	23
Compression	292	191	20
Extrusion	44	◆	◆
WELDING EQUIPMENT	112,755	50,741	5,900
Electric Welding Equipment	105,503	47,643	5,681
Power source: Motor-generator set	39,240	21,982	1,809
Transformer and rectifier	30,212	9,875	462
Arc-weld machines (not hand) incl automatic	9,837	3,740	220
Resistance welders: Spot	21,233	10,155	2,436
Gun (not hand)	1,496	356	232
Seam	863	467	32
Butt and flash	2,622	1,068	490
Gas Welding Machines (not hand)	1,276	305	39
Flame Cutting Machines (not hand)	5,976	2,793	180
HEATING EQUIPMENT	18,024	7,417	2,551
Heat-treating furnaces	8,544	4,017	1,287
Atmosphere generators	784	247	21
Stock-heating furnaces	1,963	800	496
Salt baths	1,442	612	213
Induction heating units	1,070	296	◆
Baking and drying ovens	3,803	1,294	454
Flame-hardening units	418	151	72
CLEANING AND FINISHING	18,225	6,615	2,623
Cleaning Equipment	14,179	5,051	2,428
Barrel finishing machines	6,817	2,149	1,956
Shot and abrasive blast	1,975	828	178
Parts washing machines (incl degreasers)	4,629	1,834	242
Pickling machines	758	240	52
Plating Equipment	4,046	1,564	195
Machines	1,226	390	118
Barrels	2,820	1,174	77
INDUSTRIAL TRUCKS (Power-Driven)	20,541	6,665	820
Lift (rider-type)	12,600	4,210	503
Truck-tractor	2,070	456	36
Powered hand trucks	4,403	1,421	227
Crane trucks	1,468	578	54
OTHER SHOP EQUIPMENT	17,043	6,777	1,488
Balancing Machines	591	181	34
Air Compressors	16,413	6,593	1,454
Gear-Checking Machines	39	◆	◆

Office And Service Machines

683 plants — 251,572 employees

	Total Units	10 yr & over	Over 20 yr
METAL CUTTING	71,351	66%	23%
METAL FORMING	23,271	63	27
OTHER EQUIPMENT	22,423	46	10
TOTAL	117,045	62	21

♦ — Less than 10

Typical Products: Computing and accounting machines, cash registers, typewriters; scales and balances; dictating, duplicating, mailing, sorting machines; vending machines; commercial laundry machines; industrial vacuum cleaners; commercial refrigerators; air conditioners; dispensing pumps (SIC 357, 358)

	TOTAL	10-20 YEARS	OVER 20 YR
METAL-CUTTING MACHINES	71,351	30,629	16,298
Boring Machines	1,362	543	296
Horizontal boring, drilling, & milling	254	130	55
Vertical boring mills incl vert turret lathes	335	81	169
Precision, horizontal and vertical	455	225	11
Jig boring, horizontal and vertical	306	105	59
Other (except boring lathes)	12	♦	♦
Broaching Machines	492	236	67
Horizontal internal or combination	126	45	34
Horizontal surface	87	46	10
Vertical internal	95	67	11
Vertical surface or combination	167	78	♦
Continuous horizontal & vertical	13	♦	♦
Other (incl rotary surface)	♦	♦	♦
Contour Sawing and Filing	804	346	120
Cutoff Machines	3,098	1,266	482
Bandsaw (incl friction)	1,243	511	154
Abrasive disk	416	147	46
Hacksaws	833	363	179
Circular (incl friction)	420	179	53
Other	186	66	50
Drilling Machines	19,028	8,462	4,213
Sensitive	7,089	3,446	1,693
Upright: Single-spindle	6,053	2,655	1,249
Gang	2,786	1,103	511
Radial	1,124	548	249
Multi-spindle cluster, adjustable and fixed center	996	365	276
Automatic	451	198	28
Unit head & way type (not dial)	13	♦	♦
Deep-hole drills	33	♦	14
Other (not incl special machines)	483	147	189
Gear Cutting and Finishing Machines	1,245	344	479
Hobbing machines, gear	691	185	227
Shapers, gear	211	103	36
Form-milling type (spur and bevel)	239	20	201
Bevel-gear cutters (not planer)	47	20	♦
Grinders, gear tooth	♦	♦	♦
Shavers, gear tooth	19	♦	♦
Burnishing and lapping	30	♦	♦
Chamfering, tooth pointing, tooth rounding	♦	♦	♦
Other	♦	♦	♦
Grinding Machines	14,096	6,664	2,486
External cylindrical: Plain	752	358	115
Universal	269	115	42
Internal cylindrical	266	151	44
Centerless: External	237	99	44
Internal	33	29	♦
Surface: Rotary-table type	385	194	48
Reciprocating type	2,248	1,045	420
Disk, horizontal and vertical	686	318	163
Tool and cutter (incl drill)	1,600	774	254
Bench, floorstand, and snag	6,008	3,110	1,218
Jig grinders	48	16	♦
Contour grinders	137	54	♦
Abrasive belt (not polishing)	1,132	322	94
Other (except thread grinders)	295	79	43
Honing and Lapping	689	293	154
Honing: Internal (incl combination)	325	135	72
External and surface	15	♦	♦
Lapping: Surface	252	102	82
Cylindrical	80	38	♦
Other (incl combination hone-lap)	17	10	♦
Lathes	14,103	5,990	4,019
Bench, floor, it-dy (incl turret attachment)	2,556	969	719
Engine, heavy-duty: Standard	2,366	987	822
Toolroom	1,079	457	212
Manufacturing and gap	124	33	68
Tracer	31	♦	♦
Turret lathes: Ram type	1,711	849	333
Saddle type	732	504	99
Auto chucking & between centers (single spindle)	247	48	95
Automatic chucking (multi-spindle)	290	136	61
Automatic screw machines (single spindle)	3,573	1,356	1,229
Automatic bar machines (multi-spindle)	1,285	597	361
Other (except spinning lathes)	109	54	20
Milling Machines	8,117	3,787	2,083
Bench type	226	88	89
Hand	1,349	651	387
Knee-type: Horizontal (plain & universal)	2,724	1,219	896
Vertical	1,027	485	130
Automatic & manufacturing	802	352	222
Ram type, swivel head	288	77	17
Bed (Lincoln) type, incl automatic rise and fall	728	528	29
Planer type (incl skin and spar)	83	♦	61
Profilers, duplicators, diesinkers, engravers	821	360	217
Other (except thread milling)	69	18	35
Planers	211	50	147
Double housing	153	37	113
Openside and other	58	13	34
Pipe Cutting and Threading Machines	628	210	113
Polishing and Buffing Machines	2,631	1,044	583
Polishing stands (bench and floor)	1,255	536	334
Speed lathes	275	144	62
Abrasive-belt, disk, drum	737	284	99
Other	364	80	88
Shapers	945	397	402
Horizontal	823	347	364
Vertical, incl slotters & keyseaters	122	50	38
Threading (except pipe)	1,900	878	494
Tapping	936	329	262
Hobbing and milling	79	58	♦
Die type	112	43	32
Grinders, thread	35	21	♦
Rolling machines, thread	64	♦	31
Other	674	420	165

	TOTAL	10-20 YEARS	OVER 20 YR
Electro-Erosion Machines (exc Tap disintegrators)	♦	♦	♦
Ultrasonic Cutting Machines	♦	♦	♦
Special Multi-Station Machines	1,554	81	18
In-line and transfer	1,114	♦	♦
Dial or rotary table	225	44	18
Automatic assembly (all types)	215	37	♦
Other Metal-Cutting Machines	438	35	142
METAL-FORMING MACHINES	23,271	8,490	6,227
Bending and Forming Machines (Power)	4,020	1,458	711
Bending rolls, sheet and plate	1,174	480	236
Bending rolls, bars and shapes	133	39	41
Bending brakes	2,213	789	366
Rotary bending and forming machines	176	91	♦
Bending machines, pipe, bar, and shapes	324	59	68
Wire and Strip Forming Machines	225	63	35
Hydraulic Presses	1,055	301	125
Vertical, single-action	815	231	69
Vertical, double and triple action	124	30	45
Horizontal	40	♦	♦
Extrusion (from hot billets)	♦	♦	♦
Other (incl stretch and hydro-pneumatic)	76	31	11
Pneumatic Presses (except hydro-pneumatic)	220	75	♦
Mechanical Presses (Power)	10,375	3,903	3,610
Inclinable, single-action (incl inclined)	5,274	2,092	1,746
Vertical, single-action: Straight-side (incl arch)	2,712	1,013	835
Vertical, single-action: Gap or C-frame	1,117	333	602
Vertical, single-action: Adjust. bed and horning	409	180	200
Double and triple action	86	13	36
Dieing machines	190	84	13
Horizontal (incl bulldozers)	♦	♦	♦
Multiple transfer (incl eyeletting)	28	10	♦
Other	550	172	173
Punching and Shearing Machines	3,530	1,302	722
Punching machines (incl turret)	875	316	206
Plate and sheet shears	1,697	600	354
Bar and angle shears	213	93	34
Rotary shears, incl slitters	268	121	43
Nibbling machines	384	153	67
Other	93	19	18
Forging Machinery (except presses)	300	195	58
Hammers, steam or air	19	♦	13
Hammers, mechanical (incl drop and helve)	201	167	30
Forging machines (headers) and rolls	31	20	11
Swaging machines	49	♦	♦
Other	♦	♦	♦
Riveting Machines (not portable)	3,329	1,135	948
Squeeze type	855	424	111
Rotary-vibrating type	1,052	294	408
Spinning type	650	247	228
Hammer type	772	170	201
Die Casting Machines	25	♦	♦
Hot chamber	21	♦	♦
Cold chamber	♦	♦	♦
Plastics Molding Machines	192	52	♦
Injection	81	♦	♦
Compression	103	46	♦
Extrusion	♦	♦	♦
WELDING EQUIPMENT	9,767	3,693	905
Electric Welding Equipment	9,452	3,592	875
Power source: Motor-generator set	3,258	1,420	242
Transformer and rectifier	1,307	285	32
Arc-weld machines (not hand) incl automatic	790	162	73
Resistance welders: Spot	3,395	1,491	515
Spot: Gun (not hand)	456	116	♦
Seam	202	106	♦
Butt and flash	44	12	♦
Gas Welding Machines (not hand)	100	45	12
Flame Cutting Machines (not hand)	215	56	18
HEATING EQUIPMENT	2,616	1,039	257
Heat-treating furnaces	1,105	477	142
Atmosphere generators	85	15	♦
Stock-heating furnaces	130	73	11
Salt baths	280	129	24
Induction heating units	262	98	♦
Baking and drying ovens	737	243	59
Flame-hardening units	17	♦	♦
CLEANING AND FINISHING	2,956	1,024	620
Cleaning Equipment	2,191	777	457
Barrel finishing machines	1,024	303	378
Shot and abrasive blast	185	59	15
Parts washing machines (incl degreasers)	914	366	64
Pickling machines	70	49	♦
Plating Equipment	765	247	163
Machines	334	103	18
Barrels	431	144	145
INDUSTRIAL TRUCKS (Power-Driven)	5,080	1,607	283
Lift (rider-type)	2,365	731	56
Truck-tractor	535	131	126
Powered hand trucks	2,032	685	82
Crane trucks	148	60	19
OTHER SHOP EQUIPMENT	2,004	838	150
Balancing Machines	318	175	♦
Air Compressors	1,639	644	134
Gear-Checking Machines	47	19	♦

Electrical Equipment

Typical Products: Power transformers; switchgear; motors and generators; industrial controls; welding apparatus; electrodes; lighting fixtures; wiring devices; X-ray equipment; automotive electrical equipment (SIC 361, 362, 364, 369)

1732 plants — 604,058 employees

	Total Units	10 yr & over	Over 20 yr
METAL CUTTING	111,406	57%	16%
METAL FORMING	53,259	58	21
OTHER EQUIPMENT	39,000	42	8
TOTAL	203,665	54	16

• – Less than 10

	TOTAL	10-20 YEARS	OVER 20 YR
METAL-CUTTING MACHINES	111,406	45,113	17,834
Boring Machines	3,306	1,298	658
Horizontal boring, drilling, & milling	976	436	131
Vertical boring mills incl vert turret lathes	1,073	399	390
Precision, horizontal and vertical	605	226	74
Jig boring, horizontal and vertical	608	220	54
Other (except boring lathes)	44	17	•
Broaching Machines	743	248	96
Horizontal internal or combination	255	95	21
Horizontal surface	44	24	•
Vertical internal	150	42	•
Vertical surface or combination	234	80	55
Continuous horizontal & vertical	30	•	•
Other (incl rotary surface)	30	•	•
Contour Sawing and Filing	1,119	460	137
Cutoff Machines	7,368	2,832	796
Bandsaw (incl friction)	2,786	1,146	243
Abrasive disk	981	274	48
Hacksaws	1,963	832	277
Circular (incl friction)	1,184	440	187
Other	454	140	41
Drilling Machines	27,154	10,882	4,427
Sensitive	7,622	2,971	2,035
Upright: Single-spindle	11,369	4,415	1,185
Gang	2,246	1,088	212
Radial	1,908	781	454
Multi-spindle cluster, adjustable and fixed center	1,397	559	151
Automatic	307	28	19
Unit head & way type (not dial)	147	52	13
Deep-hole drills	88	23	11
Other (not incl special machines)	2,070	965	347
Gear Cutting and Finishing Machines	1,138	386	253
Hobbing machines, gear	467	141	58
Shapers, gear	248	125	30
Form-milling type (spur and bevel)	53	11	•
Bevel-gear cutters (not planer)	233	55	127
Grinders, gear tooth	43	28	•
Shavers, gear tooth	20	10	•
Burnishing and lapping	23	•	•
Chamfering, tooth pointing, tooth rounding	12	•	•
Other	39	•	30
Grinding Machines	20,378	8,429	2,849
External cylindrical: Plain	1,643	756	192
Universal	712	224	83
Internal cylindrical	531	226	48
Centerless: External	697	372	81
Internal	100	31	16
Surface: Rotary-table type	1,611	637	206
Reciprocating type	2,493	1,045	254
Disk, horizontal and vertical	692	248	210
Tool and cutter (incl drill)	3,977	1,854	692
Bench, floorstand, and snag	5,747	2,279	919
Jig grinders	108	39	•
Contour grinders	142	59	•
Abrasive belt (not polishing)	1,370	468	66
Other (except thread grinders)	555	191	79
Honing and Lapping	977	264	34
Honing: Internal (incl combination)	310	79	•
External and surface	71	19	•
Lapping: Surface	341	92	•
Cylindrical	137	19	•
Other (incl combination hone-lap)	118	55	•
Lathes	25,309	11,242	4,181
Bench, floor, lt-dy (incl turret attachment)	5,723	2,276	602
Engine, heavy-duty: Standard	5,275	2,130	1,537
Toolroom	2,168	872	238
Manufacturing and gap	250	163	27
Tracer	104	38	•
Turret lathes: Ram type	3,372	1,750	373
Saddle type	1,093	602	92
Auto chucking & between centers (single spindle)	1,617	733	287
Automatic chucking (multi-spindle)	434	188	70
Automatic screw machines (single spindle)	3,255	1,701	502
Automatic bar machines (multi-spindle)	752	373	74
Other (except spinning lathes)	1,266	416	376
Milling Machines	10,532	3,995	1,758
Bench type	870	286	70
Hand	1,433	556	348
Knee-type: Horizontal (plain & universal)	3,573	1,443	825
Vertical	2,494	834	211
Automatic & manufacturing	357	106	63
Ram type, swivel head	641	205	56
Bed (Lincoln) type, incl automatic rise and fall	244	149	30
Planer type (incl skin and spar)	175	128	23
Profilers, duplicators, diesinkers, engravers	327	152	71
Other (except thread milling)	418	138	61
Planers	386	103	127
Double housing	232	74	75
Openside and other	154	29	52
Pipe Cutting and Threading Machines	794	246	163
Polishing and Buffing Machines	4,706	1,611	693
Polishing stands (bench and floor)	2,181	721	437
Speed lathes	529	193	52
Abrasive-belt, disk, drum	1,465	486	98
Other	531	211	108
Shapers	2,475	993	821
Horizontal	1,988	849	676
Vertical, incl slotters & keyseaters	487	146	145
Threading (except pipe)	3,903	1,784	751
Tapping	2,769	1,257	442
Hobbing and milling	213	99	99
Die type	259	134	59
Grinders, thread	77	70	•
Rolling machines, thread	441	127	153
Other	144	97	38

	TOTAL	10-20 YEARS	OVER 20 YR
Electro-Erosion Machines (exc Tap disintegrators)	30	13	•
Ultrasonic Cutting Machines	•	•	•
Special Multi-Station Machines	698	186	22
In-line and transfer	31	•	•
Dial or rotary table	280	61	•
Automatic assembly (all types)	387	119	13
Other Metal-Cutting Machines	388	139	66
METAL-FORMING MACHINES	53,259	19,610	11,449
Bending and Forming Machines (Power)	3,731	1,174	615
Bending rolls, sheet and plate	849	229	174
Bending rolls, bars and shapes	199	64	52
Bending brakes	2,180	762	293
Rotary bending and forming machines	258	70	49
Bending machines, pipe, bar, and shapes	325	49	47
Wire and Strip Forming Machines	1,353	338	230
Hydraulic Presses	5,198	1,848	713
Vertical, single-action	3,711	1,230	531
Vertical, double and triple action	910	434	96
Horizontal	126	40	13
Extrusion (from hot billets)	150	79	18
Other (incl stretch and hydro-pneumatic)	301	65	55
Pneumatic Presses (except hydro-pneumatic)	1,667	730	49
Mechanical Presses (Power)	26,186	9,777	8,025
Inclinable, single-action (incl inclined)	12,633	5,298	3,613
Vertical, single-action: Straight-side (incl arch)	4,987	1,487	1,644
Vertical, single-action: Gap or C-frame	3,533	1,384	1,165
Vertical, single-action: Adjust. bed and horning	1,066	315	426
Double and triple action	1,064	188	360
Dieing machines	400	130	56
Horizontal (incl bulldozers)	174	52	53
Multiple transfer (incl eyeletting)	898	368	190
Other	1,431	555	518
Punching and Shearing Machines	4,899	1,601	874
Punching machines (incl turret)	1,295	574	118
Plate and sheet shears	2,154	800	460
Bar and angle shears	331	101	81
Rotary shears, incl slitters	460	107	129
Nibbling machines	320	108	62
Other	369	111	24
Forging Machinery (except presses)	647	372	182
Hammers, steam or air	24	16	•
Hammers, mechanical (incl drop and helve)	180	86	75
Forging machines (headers) and rolls	239	163	75
Swaging machines	201	107	27
Other	•	•	•
Riveting Machines (not portable)	5,093	2,012	511
Squeeze type	2,239	808	158
Rotary-vibrating type	520	182	69
Spinning type	509	338	47
Hammer type	1,825	684	237
Die Casting Machines	688	153	42
Hot chamber	544	110	32
Cold chamber	144	43	10
Plastics Molding Machines	3,797	1,605	208
Injection	330	79	•
Compression	3,367	1,444	208
Extrusion	100	82	•
WELDING EQUIPMENT	14,044	5,254	1,443
Electric Welding Equipment	13,532	5,035	1,394
Power source: Motor-generator set	3,046	1,372	400
Transformer and rectifier	3,054	977	252
Arc-weld machines (not hand) incl automatic	998	283	86
Resistance welders: Spot	5,395	2,031	556
Gun (not hand)	73	•	•
Seam	295	104	38
Butt and flash	671	267	62
Gas Welding Machines (not hand)	157	95	•
Flame Cutting Machines (not hand)	355	124	49
HEATING EQUIPMENT	8,721	2,825	834
Heat-treating furnaces	2,558	998	331
Atmosphere generators	109	28	•
Stock-heating furnaces	619	235	71
Salt baths	538	253	63
Induction heating units	596	97	•
Baking and drying ovens	4,216	1,208	356
Flame-hardening units	85	•	•
CLEANING AND FINISHING	6,241	2,131	465
Cleaning Equipment	4,528	1,519	386
Barrel finishing machines	1,802	693	270
Shot and abrasive blast	648	162	45
Parts washing machines (incl degreasers)	1,920	599	59
Pickling machines	158	65	12
Plating Equipment	1,713	612	79
Machines	831	226	55
Barrels	882	386	24
INDUSTRIAL TRUCKS (Power-Driven)	5,214	1,532	103
Lift (rider-type)	2,587	800	24
Truck-tractor	811	277	30
Powered hand trucks	1,722	420	44
Crane trucks	94	35	5
OTHER SHOP EQUIPMENT	4,780	1,635	263
Balancing Machines	1,163	485	89
Air Compressors	3,442	1,109	171
Gear-Checking Machines	175	41	•

Household Appliances

316 plants — 158,920 employees

	Total Units	10 yr & over	Over 20 yr
METAL CUTTING	28,830	66%	16%
METAL FORMING	11,252	57	17
OTHER EQUIPMENT	12,457	44	7
TOTAL	52,539	59	14

Typical Products: Household stoves, refrigerators, fans, vacuum cleaners, sewing machines, appliances, water heaters, food-disposal units (SIC 363)

◆ – Less than 10

	TOTAL	10-20 YEARS	OVER 20 YR
METAL-CUTTING MACHINES	**28,830**	**14,459**	**4,647**
Boring Machines	**1,114**	**473**	**151**
Horizontal boring, drilling, & milling	274	125	56
Vertical boring mills incl vert turret lathes	138	51	20
Precision, horizontal and vertical	583	252	38
Jig boring, horizontal and vertical	90	42	18
Other (except boring lathes)	29	◆	19
Broaching Machines	**178**	**111**	**13**
Horizontal internal or combination	64	39	◆
Horizontal surface	23	23	◆
Vertical internal	49	33	◆
Vertical surface or combination	41	15	◆
Continuous horizontal & vertical	◆	◆	◆
Other (incl rotary surface)	◆	◆	◆
Contour Sawing and Filing	**266**	**98**	**41**
Cutoff Machines	**1,175**	**459**	**132**
Bandsaw (incl friction)	519	195	44
Abrasive disk	106	48	◆
Hacksaws	272	120	52
Circular (incl friction)	137	64	24
Other	141	32	◆
Drilling Machines	**7,884**	**3,846**	**1,474**
Sensitive	1,085	463	202
Upright: Single-spindle	4,423	2,248	898
Gang	969	554	181
Radial	279	99	58
Multi-spindle cluster, adjustable and fixed center	359	120	25
Automatic	144	78	◆
Unit head & way type (not dial)	150	31	33
Deep-hole drills	66	37	◆
Other (not incl special machines)	409	216	69
Gear Cutting and Finishing Machines	**577**	**394**	**45**
Hobbing machines, gear	241	147	26
Shapers, gear	215	183	◆
Form-milling type (spur and bevel)	◆	◆	◆
Bevel-gear cutters (not planer)	28	◆	19
Grinders, gear tooth	◆	◆	◆
Shavers, gear tooth	47	23	◆
Burnishing and lapping	26	18	◆
Chamfering, tooth pointing, tooth rounding	16	16	◆
Other	◆	◆	◆
Grinding Machines	**5,355**	**2,828**	**612**
External cylindrical: Plain	448	285	64
Universal	157	102	◆
Internal cylindrical	210	120	30
Centerless: External	517	248	15
Internal	45	17	◆
Surface: Rotary-table type	406	195	58
Reciprocating type	638	325	61
Disk, horizontal and vertical	277	130	30
Tool and cutter (incl drill)	1,115	577	142
Bench, floorstand, and snag	1,211	686	184
Jig grinders	12	◆	◆
Contour grinders	27	13	◆
Abrasive belt (not polishing)	197	94	◆
Other (except thread grinders)	95	36	15
Honing and Lapping	**584**	**246**	**89**
Honing: Internal (incl combination)	225	76	◆
External and surface	23	◆	◆
Lapping: Surface	80	26	35
Cylindrical	229	124	43
Other (incl combination hone-lap)	27	12	◆
Lathes	**4,507**	**2,428**	**700**
Bench, floor, lt-dy (incl turret attachment)	926	391	152
Engine, heavy-duty: Standard	813	448	102
Toolroom	401	217	23
Manufacturing and gap	165	104	◆
Tracer	12	◆	◆
Turret lathes: Ram type	627	424	129
Saddle type	30	26	◆
Auto chucking & between centers (single spindle)	97	29	41
Automatic chucking (multi-spindle)	133	71	12
Automatic screw machines (single spindle)	893	462	182
Automatic bar machines (multi-spindle)	285	201	◆
Other (except spinning lathes)	125	55	51
Milling Machines	**3,789**	**2,042**	**786**
Bench type	161	75	43
Hand	342	199	65
Knee-type: Horizontal (plain & universal)	819	448	98
Vertical	394	205	32
Automatic & manufacturing	865	575	167
Ram type, swivel head	129	47	◆
Bed (Lincoln) type, incl automatic rise and fall	257	196	◆
Planer type (incl skin and spar)	190	87	25
Profilers, duplicators, diesinkers, engravers	135	61	15
Other (except thread milling)	497	149	299
Planers	**90**	**19**	**29**
Double housing	53	18	21
Openside and other	37	◆	◆
Pipe Cutting and Threading Machines	**207**	**74**	**38**
Polishing and Buffing Machines	**1,733**	**788**	**367**
Polishing stands (bench and floor)	892	494	194
Speed lathes	188	44	114
Abrasive-belt, disk, drum	273	134	12
Other	380	116	47
Shapers	**400**	**234**	**70**
Horizontal	335	204	50
Vertical, incl slotters & keyseaters	65	30	20
Threading (except pipe)	**643**	**336**	**85**
Tapping	537	275	83
Hobbing and milling	30	23	◆
Die type	21	19	◆
Grinders, thread	10	◆	◆
Rolling machines, thread	47	11	◆
Other	18	◆	◆

	TOTAL	10-20 YEARS	OVER 20 YR
Electro-Erosion Machines (exc Tap disintegrators)	◆	◆	◆
Ultrasonic Cutting Machines	◆	◆	◆
Special Multi-Station Machines	**152**	**11**	**◆**
In-line and transfer	35	◆	◆
Dial or rotary table	115	10	◆
Automatic assembly (all types)	◆	◆	◆
Other Metal-Cutting Machines	**169**	**72**	**45**
METAL-FORMING MACHINES	**11,252**	**4,440**	**1,946**
Bending and Forming Machines (Power)	**1,337**	**489**	**119**
Bending rolls, sheet and plate	493	153	43
Bending rolls, bars and shapes	84	20	◆
Bending brakes	577	270	74
Rotary bending and forming machines	78	17	◆
Bending machines, pipe, bar, and shapes	105	29	◆
Wire and Strip Forming Machines	**173**	**63**	**35**
Hydraulic Presses	**798**	**254**	**127**
Vertical, single-action	415	159	81
Vertical, double and triple action	191	58	44
Horizontal	36	◆	◆
Extrusion (from hot billets)	◆	◆	◆
Other (incl stretch and hydro-pneumatic)	62	29	◆
Pneumatic Presses (except hydro-pneumatic)	**208**	**125**	**14**
Mechanical Presses (Power)	**5,866**	**2,358**	**1,219**
Inclinable, single-action (incl inclined)	2,780	1,194	611
Vertical, single-action: Straight-side (incl arch)	1,458	557	241
Vertical, single-action: Gap or C-frame	799	252	185
Vertical, single-action: Adjust. bed and horning	398	203	80
Double and triple action	193	64	63
Dieing machines	34	20	◆
Horizontal (incl bulldozers)	67	34	25
Multiple transfer (incl eyeletting)	44	◆	◆
Other	93	27	14
Punching and Shearing Machines	**1,083**	**470**	**271**
Punching machines (incl turret)	222	118	67
Plate and sheet shears	606	264	154
Bar and angle shears	44	23	10
Rotary shears, incl slitters	80	29	21
Nibbling machines	101	32	◆
Other	30	◆	10
Forging Machinery (except presses)	**85**	**42**	**◆**
Hammers, steam or air	◆	◆	◆
Hammers, mechanical (incl drop and helve)	◆	◆	◆
Forging machines (headers) and rolls	◆	◆	◆
Swaging machines	71	35	◆
Other	◆	◆	◆
Riveting Machines (not portable)	**1,313**	**524**	**142**
Squeeze type	827	351	48
Rotary-vibrating type	132	67	23
Spinning type	72	29	◆
Hammer type	282	77	62
Die Casting Machines	**109**	**51**	**◆**
Hot chamber	99	48	◆
Cold chamber	10	◆	◆
Plastics Molding Machines	**370**	**64**	**◆**
Injection	50	28	◆
Compression	320	36	◆
Extrusion	◆	◆	◆
WELDING EQUIPMENT	**6,190**	**2,314**	**371**
Electric Welding Equipment	**6,129**	**2,296**	**370**
Power source: Motor-generator set	955	293	42
Transformer and rectifier	396	174	11
Arc-weld machines (not hand) incl automatic	527	120	69
Resistance welders: Spot	3,238	1,286	205
Gun (not hand)	624	272	16
Seam	264	128	21
Butt and flash	125	23	◆
Gas Welding Machines (not hand)	**50**	**17**	**◆**
Flame Cutting Machines (not hand)	**11**	**◆**	**◆**
HEATING EQUIPMENT	**1,475**	**703**	**156**
Heat-treating furnaces	461	241	38
Atmosphere generators	32	◆	◆
Stock-heating furnaces	47	23	◆
Salt baths	126	59	12
Induction heating units	225	143	◆
Baking and drying ovens	584	228	97
Flame-hardening units	◆	◆	◆
CLEANING AND FINISHING	**1,714**	**662**	**190**
Cleaning Equipment	**1,479**	**507**	**166**
Barrel finishing machines	666	194	105
Shot and abrasive blast	169	79	◆
Parts washing machines (incl degreasers)	549	187	28
Pickling machines	95	47	25
Plating Equipment	**235**	**155**	**24**
Machines	201	127	24
Barrels	34	28	◆
INDUSTRIAL TRUCKS (Power-Driven)	**2,074**	**545**	**32**
Lift (rider-type)	1,309	443	20
Truck-tractor	148	25	◆
Powered hand trucks	590	77	◆
Crane trucks	27	◆	◆
OTHER SHOP EQUIPMENT	**1,004**	**394**	**124**
Balancing Machines	**249**	**50**	**56**
Air Compressors	**704**	**306**	**68**
Gear-Checking Machines	**51**	**38**	**◆**

Communications Equipment

Typical Products: Radio—TV receiving sets; telephone and telegraph apparatus; radio—TV transmitting equipment; missile control systems; electron tubes; electronic accessories; cathode-ray picture tubes; phonograph records; aircraft control systems (SIC 365, 366, 367)

1016 plants — 443,411 employees

	Total Units	10 yr & over	Over 20 yr
METAL CUTTING	53,524	42%	6%
METAL FORMING	18,996	42	9
OTHER EQUIPMENT	20,525	20	2
TOTAL	93,045	37	6

• – Less than 10

	TOTAL	10-20 YEARS	OVER 20 YR
METAL-CUTTING MACHINES	53,524	19,104	3,277
Boring Machines	1,227	257	11
Horizontal boring, drilling, & milling	417	124	•
Vertical boring mills incl vert turret lathes	229	40	•
Precision, horizontal and vertical	84	13	•
Jig boring, horizontal and vertical	468	74	•
Other (except boring lathes)	29	•	•
Broaching Machines	105	47	11
Horizontal internal or combination	34	18	•
Horizontal surface	•	•	•
Vertical internal	32	•	•
Vertical surface or combination	23	17	•
Continuous horizontal & vertical	•	•	•
Other (incl rotary surface)	•	•	•
Contour Sawing and Filing	702	258	25
Cutoff Machines	3,076	950	144
Bandsaw (incl friction)	1,322	428	55
Abrasive disk	410	130	•
Hacksaws	726	260	45
Circular (incl friction)	416	97	17
Other	202	35	23
Drilling Machines	13,450	5,236	792
Sensitive	2,279	788	173
Upright: Single-spindle	7,031	2,828	282
Gang	2,264	787	199
Radial	322	159	48
Multi-spindle cluster, adjustable and fixed center	470	164	19
Automatic	149	15	•
Unit head & way type (not dial)	26	12	•
Deep-hole drills	34	19	•
Other (not incl special machines)	875	454	66
Gear Cutting and Finishing Machines	667	201	74
Hobbing machines, gear	458	135	16
Shapers, gear	89	42	•
Form-milling type (spur and bevel)	58	•	39
Bevel-gear cutters (not planer)	•	•	•
Grinders, gear tooth	14	11	•
Shavers, gear tooth	21	12	•
Burnishing and lapping	•	•	•
Chamfering, tooth pointing, tooth rounding	16	•	16
Other	•	•	•
Grinding Machines	10,218	3,500	591
External cylindrical: Plain	487	218	19
Universal	357	116	24
Internal cylindrical	156	25	11
Centerless: External	164	78	16
Internal	12	•	•
Surface: Rotary-table type	485	117	25
Reciprocating type	2,303	766	152
Disk, horizontal and vertical	251	71	37
Tool and cutter (incl drill)	1,472	472	122
Bench, floorstand, and snag	2,769	878	146
Jig grinders	72	18	•
Contour grinders	107	52	•
Abrasive belt (not polishing)	1,302	495	23
Other (except thread grinders)	281	188	•
Honing and Lapping	586	66	•
Honing: Internal (incl combination)	200	16	•
External and surface	72	25	•
Lapping: Surface	214	•	•
Cylindrical	•	•	•
Other (incl combination hone-lap)	91	20	•
Lathes	11,489	4,305	766
Bench, floor, lt-dy (incl turret attachment)	4,388	1,442	311
Engine, heavy-duty: Standard	1,783	685	133
Toolroom	1,392	568	84
Manufacturing and gap	107	38	•
Tracer	61	•	•
Turret lathes: Ram type	818	253	39
Saddle type	392	198	44
Auto chucking & between centers (single spindle)	65	10	16
Automatic chucking (multi-spindle)	13	•	•
Automatic screw machines (single spindle)	1,855	841	69
Automatic bar machines (multi-spindle)	168	55	26
Other (except spinning lathes)	447	204	39
Milling Machines	6,942	2,334	347
Bench type	475	230	23
Hand	543	311	28
Knee-type: Horizontal (plain & universal)	1,954	541	210
Vertical	1,896	422	41
Automatic & manufacturing	579	298	17
Ram type, swivel head	344	108	•
Bed (Lincoln) type, incl automatic rise and fall	399	190	•
Planer type (incl skin and spar)	28	16	•
Profilers, duplicators, diesinkers, engravers	553	202	•
Other (except thread milling)	171	16	•
Planers	93	43	21
Double housing	78	59	19
Openside and other	15	•	•
Pipe Cutting and Threading Machines	281	64	•
Polishing and Buffing Machines	2,048	652	182
Polishing stands (bench and floor)	808	240	84
Speed lathes	421	223	42
Abrasive-belt, disk, drum	646	154	15
Other	185	35	41
Shapers	869	509	126
Horizontal	734	432	117
Vertical, incl slotters & keyseaters	135	77	•
Threading (except pipe)	1,123	582	144
Tapping	986	532	120
Hobbing and milling	32	•	19
Die type	15	•	•
Grinders, thread	15	•	•
Rolling machines, thread	51	33	•
Other	24	•	•

	TOTAL	10-20 YEARS	OVER 20 YR
Electro-Erosion Machines (exc Tap disintegrators)	11	•	•
Ultrasonic Cutting Machines	39	•	•
Special Multi-Station Machines	411	68	•
In-line and transfer	27	•	•
Dial or rotary table	97	19	•
Automatic assembly (all types)	287	49	•
Other Metal-Cutting Machines	175	21	26
METAL-FORMING MACHINES	18,996	6,272	1,686
Bending and Forming Machines (Power)	1,540	535	98
Bending rolls, sheet and plate	212	93	13
Bending rolls, bars and shapes	35	13	•
Bending brakes	960	340	36
Rotary bending and forming machines	199	82	39
Bending machines, pipe, bar, and shapes	134	•	10
Wire and Strip Forming Machines	757	235	63
Hydraulic Presses	1,434	326	82
Vertical, single-action	1,015	223	64
Vertical, double and triple action	142	67	18
Horizontal	167	32	•
Extrusion (from hot billets)	•	•	•
Other (incl stretch and hydro-pneumatic)	110	•	•
Pneumatic Presses (except hydro-pneumatic)	648	126	•
Mechanical Presses (Power)	7,237	2,841	1,016
Inclinable, single-action (incl inclined)	5,060	2,148	772
Vertical, single-action: Straight-side (incl arch)	745	202	88
Vertical, single-action: Gap or C-frame	538	185	55
Vertical, single-action: Adjust. bed and horning	187	114	23
Double and triple action	68	•	•
Dieing machines	47	•	•
Horizontal (incl bulldozers)	144	86	40
Multiple transfer (incl eyeletting)	235	69	21
Other	213	31	12
Punching and Shearing Machines	2,844	535	119
Punching machines (incl turret)	749	157	65
Plate and sheet shears	850	263	45
Bar and angle shears	41	11	•
Rotary shears, incl slitters	52	•	•
Nibbling machines	243	46	•
Other	109	52	•
Forging Machinery (except presses)	106	13	19
Hammers, steam or air	•	•	•
Hammers, mechanical (incl drop and helve)	58	•	•
Forging machines (headers) and rolls	22	•	•
Swaging machines	17	•	•
Other	•	•	•
Riveting Machines (not portable)	3,939	1,273	287
Squeeze type	1,747	459	17
Rotary-vibrating type	721	287	30
Spinning type	280	88	143
Hammer type	1,191	439	17
Die Casting Machines	62	•	•
Hot chamber	62	•	•
Cold chamber	•	•	•
Plastics Molding Machines	1,229	385	79
Injection	440	97	41
Compression	751	288	38
Extrusion	38	•	•
WELDING EQUIPMENT	7,443	1,159	147
Electric Welding Equipment	7,328	1,137	146
Power source: Motor-generator set	684	193	38
Transformer and rectifier	938	143	•
Arc-weld machines (not hand) incl automatic	200	58	15
Resistance welders: Spot	5,292	710	84
Gun (not hand)	•	•	•
Seam	24	11	•
Butt and flash	181	22	•
Gas Welding Machines (not hand)	96	16	•
Flame Cutting Machines (not hand)	19	•	•
HEATING EQUIPMENT	6,047	912	119
Heat-treating furnaces	1,488	338	24
Atmosphere generators	87	•	•
Stock-heating furnaces	850	124	22
Salt baths	183	49	22
Induction heating units	1,092	122	26
Baking and drying ovens	2,337	276	25
Flame-hardening units	10	•	•
CLEANING AND FINISHING	3,537	956	116
Cleaning Equipment	2,276	599	91
Barrel finishing machines	871	294	55
Shot and abrasive blast	223	39	20
Parts washing machines (incl degreasers)	1,131	246	16
Pickling machines	51	20	•
Plating Equipment	1,261	357	25
Machines	657	91	15
Barrels	604	266	10
INDUSTRIAL TRUCKS (Power-Driven)	1,594	222	16
Lift (rider-type)	982	131	10
Truck-tractor	123	•	•
Powered hand trucks	466	82	•
Crane trucks	23	•	•
OTHER SHOP EQUIPMENT	1,904	516	52
Balancing Machines	46	•	•
Air Compressors	1,799	488	51
Gear-Checking Machines	59	21	•

Motor Vehicles And Parts

1114 plants — 673,337 employees

	Total Units	10 yr & over	Over 20 yr
METAL CUTTING	124,874	46%	18%
METAL FORMING	39,011	50	25
OTHER EQUIPMENT	63,816	29	7
TOTAL	227,701	42	16

• – Less than 10

Typical Products: Automobiles, busses, hearses, taxicabs, trucks; passenger-car bodies; truck and bus bodies; motor vehicle parts; truck trailers; motorcycles, bicycles, and parts; trailers (SIC 371, 375, 379)

	TOTAL	10-20 YEARS	OVER 20 YR
METAL-CUTTING MACHINES	124,874	35,013	22,670
Boring Machines	6,216	1,182	521
Horizontal boring, drilling, & milling	1,257	263	143
Vertical boring mills incl vert turret lathes	498	131	99
Precision, horizontal and vertical	3,512	489	169
Jig boring, horizontal and vertical	292	81	55
Other (except boring lathes)	657	218	55
Broaching Machines	2,841	643	472
Horizontal internal or combination	519	126	202
Horizontal surface	291	54	20
Vertical internal	608	100	82
Vertical surface or combination	960	270	126
Continuous horizontal & vertical	87	•	•
Other (incl rotary surface)	376	88	41
Contour Sawing and Filing	498	150	94
Cutoff Machines	4,286	1,482	445
Bandsaw (incl friction)	1,906	621	184
Abrasive disk	606	189	62
Hacksaws	935	432	121
Circular (incl friction)	382	121	21
Other	457	119	57
Drilling Machines	24,258	7,416	6,745
Sensitive	4,461	1,436	1,318
Upright: Single-spindle	9,308	3,174	3,079
Gang	2,006	893	628
Radial	1,439	484	330
Multi-spindle cluster, adjustable and fixed center	1,447	378	365
Automatic	273	49	27
Unit head & way type (not dial)	789	161	129
Deep-hole drills	150	53	25
Other (not incl special machines)	4,385	788	844
Gear Cutting and Finishing Machines	8,679	2,092	1,662
Hobbing machines, gear	2,556	652	602
Shapers, gear	1,510	409	328
Form-milling type (spur and bevel)	68	•	38
Bevel-gear cutters (not planer)	2,133	540	352
Grinders, gear tooth	78	26	18
Shavers, gear tooth	836	193	72
Burnishing and lapping	699	91	144
Chamfering, tooth pointing, tooth rounding	559	140	81
Other	240	37	27
Grinding Machines	29,529	8,823	5,110
External cylindrical: Plain	3,798	1,104	730
Universal	945	324	105
Internal cylindrical	1,709	391	207
Centerless: External	2,626	841	244
Internal	177	33	21
Surface: Rotary-table type	1,875	622	298
Reciprocating type	1,520	488	241
Disk, horizontal and vertical	927	206	162
Tool and cutter (incl drill)	8,630	2,753	2,000
Bench, floorstand, and snag	3,505	1,285	686
Jig grinders	62	11	•
Contour grinders	336	46	22
Abrasive belt (not polishing)	465	123	28
Other (except thread grinders)	2,954	596	366
Honing and Lapping	2,166	433	93
Honing: Internal (incl combination)	903	176	24
External and surface	161	17	•
Lapping: Surface	450	113	40
Cylindrical	384	118	19
Other (incl combination hone-lap)	268	•	•
Lathes	18,787	6,357	3,685
Bench, floor, ft-dy (incl turret attachment)	972	517	151
Engine, heavy-duty: Standard	3,560	1,259	1,113
Toolroom	993	389	203
Manufacturing and gap	732	192	247
Tracer	154	•	•
Turret lathes: Ram type	1,144	641	203
Saddle type	745	336	179
Auto chucking & between centers (single spindle)	2,935	951	577
Automatic chucking (multi-spindle)	2,654	631	421
Automatic screw machines (single spindle)	2,634	863	280
Automatic bar machines (multi-spindle)	942	347	84
Other (except spinning lathes)	1,322	222	227
Milling Machines	7,377	2,525	1,647
Bench type	116	66	•
Hand	635	280	227
Knee-type: Horizontal (plain & universal)	1,853	673	530
Vertical	1,011	379	132
Automatic & manufacturing	1,055	385	290
Ram type, swivel head	104	17	•
Bed (Lincoln) type, incl automatic rise and fall	610	247	141
Planer type (incl skin and spar)	95	12	20
Profilers, duplicators, diesinkers, engravers	572	157	74
Other (except thread milling)	1,326	309	260
Planers	367	94	144
Double housing	191	49	77
Openside and other	176	45	67
Pipe Cutting and Threading Machines	746	215	78
Polishing and Buffing Machines	6,176	2,068	798
Polishing stands (bench and floor)	3,195	1,095	405
Speed lathes	1,259	278	319
Abrasive-belt, disk, drum	713	221	24
Other	1,009	474	50
Shapers	1,716	590	528
Horizontal	1,403	489	437
Vertical, incl slotters & keyseaters	313	101	91
Threading (except pipe)	2,177	610	536
Tapping	1,000	311	256
Hobbing and milling	140	29	31
Die type	258	102	83
Grinders, thread	317	92	23
Rolling machines, thread	303	61	133
Other	159	15	10

	TOTAL	10-20 YEARS	OVER 20 YR
Electro-Erosion Machines (exc Tap disintegrators)	10	•	•
Ultrasonic Cutting Machines	17	•	•
Special Multi-Station Machines	8,249	169	42
In-line and transfer	6,432	23	•
Dial or rotary table	581	108	21
Automatic assembly (all types)	1,236	38	13
Other Metal-Cutting Machines	779	164	70
METAL-FORMING MACHINES	39,011	9,478	9,908
Bending and Forming Machines (Power)	2,933	810	464
Bending rolls, sheet and plate	912	214	137
Bending rolls, bars and shapes	161	50	40
Bending brakes	769	260	150
Rotary bending and forming machines	248	53	47
Bending machines, pipe, bar, and shapes	843	233	90
Wire and Strip Forming Machines	367	85	43
Hydraulic Presses	1,949	430	351
Vertical, single-action	1,424	314	284
Vertical, double and triple action	153	52	20
Horizontal	57	17	•
Extrusion (from hot billets)	77	18	21
Other (incl stretch and hydro-pneumatic)	238	29	21
Pneumatic Presses (except hydro-pneumatic)	384	126	11
Mechanical Presses (Power)	25,858	6,055	7,091
Inclinable, single-action (incl inclined)	6,521	1,928	1,947
Vertical, single-action: Straight-side (incl arch)	5,032	1,210	801
Vertical, single-action: Gap or C-frame	6,435	1,346	1,940
Vertical, single-action: Adjust. bed and horning	2,605	709	829
Double and triple action	475	31	184
Dieing machines	157	32	36
Horizontal (incl bulldozers)	66	23	17
Multiple transfer (incl eyeletting)	132	8	28
Other	4,435	768	309
Punching and Shearing Machines	2,188	489	580
Punching machines (incl turret)	51	•	•
Plate and sheet shears	1,202	291	339
Bar and angle shears	306	82	42
Rotary shears, incl slitters	190	57	56
Nibbling machines	172	47	36
Other	267	10	68
Forging Machinery (except presses)	1,633	443	668
Hammers, steam or air	564	168	316
Hammers, mechanical (incl drop and helve)	96	29	52
Forging machines (headers) and rolls	760	199	253
Swaging machines	128	27	44
Other	85	20	•
Riveting Machines (not portable)	3,285	961	719
Squeeze type	1,222	358	219
Rotary-vibrating type	393	105	122
Spinning type	301	92	41
Hammer type	1,369	406	343
Die Casting Machines	316	34	•
Hot chamber	210	•	•
Cold chamber	106	25	•
Plastics Molding Machines	98	45	•
Injection	39	23	•
Compression	55	22	•
Extrusion	•	•	•
WELDING EQUIPMENT	34,906	7,936	1,604
Electric Welding Equipment	34,283	7,729	1,542
Power source: Motor-generator set	7,680	3,285	793
Transformer and rectifier	12,693	1,865	27
Arc-weld machines (not hand) incl automatic	2,511	648	89
Resistance welders: Spot	9,693	1,438	505
Gun (not hand)	982	287	22
Seam	255	74	46
Butt and flash	469	132	60
Gas Welding Machines (not hand)	324	77	48
Flame Cutting Machines (not hand)	299	130	14
HEATING EQUIPMENT	8,930	2,491	1,384
Heat-treating furnaces	3,956	1,327	800
Atmosphere generators	223	26	•
Stock-heating furnaces	1,552	375	270
Salt baths	990	259	165
Induction heating units	966	241	30
Baking and drying ovens	1,077	234	32
Flame-hardening units	166	29	•
CLEANING AND FINISHING	5,970	1,233	391
Cleaning Equipment	5,364	1,026	359
Barrel finishing machines	663	169	53
Shot and abrasive blast	946	227	25
Parts washing machines (incl degreasers)	3,668	594	275
Pickling machines	87	36	•
Plating Equipment	606	207	32
Machines	493	130	32
Barrels	113	77	•
INDUSTRIAL TRUCKS (Power-Driven)	9,395	1,614	400
Lift (rider-type)	4,602	922	150
Truck-tractor	1,767	209	26
Powered hand trucks	2,623	415	145
Crane trucks	403	68	79
OTHER SHOP EQUIPMENT	4,615	988	618
Balancing Machines	1,747	296	234
Air Compressors	1,395	392	152
Gear-Checking Machines	1,473	300	232

Complete Aircraft

Typical Products: Manufacture or assembly of complete aircraft, such as airplanes, autogiros, dirigibles, gliders, and helicopters (SIC 3721)

53 plants — 512,387 employees

	Total Units	10 yr & over	Over 20 yr
METAL CUTTING	24,962	50%	1%
METAL FORMING	9,160	52	1
OTHER EQUIPMENT	6,144	42	0
TOTAL	40,266	49	1

• – Less than 10

	TOTAL	10-20 YEARS	OVER 20 YR
METAL-CUTTING MACHINES	24,962	12,250	257
Boring Machines	731	294	•
Horizontal boring, drilling, & milling	147	84	•
Vertical boring mills incl vert turret lathes	64	26	•
Precision, horizontal and vertical	118	45	•
Jig boring, horizontal and vertical	367	136	•
Other (except boring lathes)	•	•	•
Broaching Machines	65	41	•
Horizontal internal or combination	20	14	•
Horizontal surface	•	•	•
Vertical internal	•	•	•
Vertical surface or combination	•	•	•
Continuous horizontal & vertical	•	•	•
Other (incl rotary surface)	32	18	•
Contour Sawing and Filing	828	395	•
Cutoff Machines	2,247	971	20
Bandsaw (incl friction)	1,072	424	11
Abrasive disk	208	60	•
Hacksaws	362	218	•
Circular (incl friction)	490	238	•
Other	115	31	•
Drilling Machines	6,605	4,007	43
Sensitive	3,223	2,128	•
Upright: Single-spindle	2,189	1,264	•
Gang	281	78	30
Radial	592	306	•
Multi-spindle cluster, adjustable and fixed center	134	97	•
Automatic	18	•	•
Unit head & way type (not dial)	•	•	•
Deep-hole drills	•	•	•
Other (not incl special machines)	157	125	•
Gear Cutting and Finishing Machines	104	•	•
Hobbing machines, gear	23	•	•
Shapers, gear	28	•	•
Form-milling type (spur and bevel)	•	•	•
Bevel-gear cutters (not planer)	•	•	•
Grinders, gear tooth	36	•	•
Shavers, gear tooth	•	•	•
Burnishing and lapping	•	•	•
Chamfering, tooth pointing, tooth rounding	•	•	•
Other	•	•	•
Grinding Machines	5,357	2,783	55
External cylindrical: Plain	133	64	•
Universal	163	47	•
Internal cylindrical	37	22	•
Centerless: External	77	30	•
Internal	•	•	•
Surface: Rotary-table type	66	32	•
Reciprocating type	280	133	•
Disk, horizontal and vertical	400	246	•
Tool and cutter (incl drill)	1,072	459	•
Bench, floorstand, and snag	2,286	1,403	20
Jig grinders	20	•	•
Contour grinders	87	56	•
Abrasive belt (not polishing)	564	180	•
Other (except thread grinders)	170	109	•
Honing and Lapping	135	22	•
Honing: Internal (incl combination)	87	13	•
External and surface	10	•	•
Lapping: Surface	10	•	•
Cylindrical	•	•	•
Other (incl combination hone-lap)	24	•	•
Lathes	3,031	1,280	69
Bench, floor, ti-dy (incl turret attachment)	500	227	15
Engine, heavy-duty: Standard	910	488	15
Toolroom	533	153	11
Manufacturing and gap	71	15	•
Tracer	60	•	•
Turret lathes: Ram type	684	298	13
Saddle type	118	44	•
Auto chucking & between centers (single spindle)	17	•	•
Automatic chucking (multi-spindle)	•	•	•
Automatic screw machines (single spindle)	100	38	•
Automatic bar machines (multi-spindle)	•	•	•
Other (except spinning lathes)	33	11	•
Milling Machines	3,640	1,552	21
Bench type	58	29	•
Hand	100	50	•
Knee-type: Horizontal (plain & universal)	1,813	827	15
Vertical	580	259	•
Automatic & manufacturing	100	19	•
Ram type, swivel head	63	30	•
Bed (Lincoln) type, incl automatic rise and fall	125	61	•
Planer type (incl skin and spar)	226	55	•
Profilers, duplicators, diesinkers, engravers	500	202	•
Other (except thread milling)	75	22	•
Planers	98	55	•
Double housing	18	14	•
Openside and other	72	41	•
Pipe Cutting and Threading Machines	117	52	•
Polishing and Buffing Machines	1,341	443	33
Polishing stands (bench and floor)	154	85	•
Speed lathes	68	26	•
Abrasive-belt, disk, drum	1,091	324	27
Other	28	•	•
Shapers	458	276	•
Horizontal	339	220	•
Vertical, incl slotters & keyseaters	119	56	•
Threading (except pipe)	131	54	•
Tapping	36	17	•
Hobbing and milling	18	11	•
Die type	25	•	•
Grinders, thread	48	18	•
Rolling machines, thread	•	•	•
Other	•	•	•

	TOTAL	10-20 YEARS	OVER 20 YR
Electro-Erosion Machines (exc Tap disintegrators)	37	•	•
Ultrasonic Cutting Machines	•	•	•
Special Multi-Station Machines	15	•	•
In-line and transfer	•	•	•
Dial or rotary table	•	•	•
Automatic assembly (all types)	•	•	•
Other Metal-Cutting Machines	56	18	•
METAL-FORMING MACHINES	9,160	4,476	133
Bending and Forming Machines (Power)	2,566	955	38
Bending rolls, sheet and plate	356	162	•
Bending rolls, bars and shapes	114	67	•
Bending brakes	749	303	16
Rotary bending and forming machines	400	181	12
Bending machines, pipe, bar, and shapes	947	242	•
Wire and Strip Forming Machines	27	•	•
Hydraulic Presses	589	240	10
Vertical, single-action	320	132	•
Vertical, double and triple action	60	22	•
Horizontal	•	•	•
Extrusion (from hot billets)	•	•	•
Other (incl stretch and hydro-pneumatic)	204	82	•
Pneumatic Presses (except hydro-pneumatic)	20	14	
Mechanical Presses (Power)	1,112	504	41
Inclinable, single-action (incl inclined)	485	232	19
Vertical, single-action: Straight-side (incl arch)	174	90	•
Vertical, single-action: Gap or C-frame	113	34	•
Vertical, single-action: Adjust. bed and horning	13	•	•
Double and triple action	40	31	•
Dieing machines	21	•	•
Horizontal (incl bulldozers)	17	•	•
Multiple transfer (incl eyeletting)	•	•	•
Other	249	101	15
Punching and Shearing Machines	1,265	703	21
Punching machines (incl turret)	195	104	•
Plate and sheet shears	715	360	13
Bar and angle shears	48	27	•
Rotary shears, incl slitters	60	32	•
Nibbling machines	149	110	•
Other	98	70	•
Forging Machinery (except presses)	462	277	8
Hammers, steam or air	102	80	•
Hammers, mechanical (incl drop and helve)	191	119	•
Forging machines (headers) and rolls	33	18	•
Swaging machines	63	34	•
Other	73	26	•
Riveting Machines (not portable)	3,114	1,971	36
Squeeze type	2,661	1,729	15
Rotary-vibrating type	44	21	•
Spinning type	31	10	•
Hammer type	378	211	•
Die Casting Machines	•	•	•
Hot chamber	•	•	•
Cold chamber	•	•	•
Plastics Molding Machines	•	•	•
Injection	•	•	•
Compression	•	•	•
Extrusion	•	•	•
WELDING EQUIPMENT	2,584	1,273	•
Electric Welding Equipment	2,499	1,252	•
Power source: Motor-generator set	1,010	579	•
Transformer and rectifier	613	260	•
Arc-weld machines (not hand) incl automatic	201	76	•
Resistance welders: Spot	418	218	•
Gun (not hand)	64	35	•
Seam	106	34	•
Butt and flash	87	50	•
Gas Welding Machines (not hand)	25	•	•
Flame Cutting Machines (not hand)	60	17	•
HEATING EQUIPMENT	772	353	11
Heat-treating furnaces	315	135	•
Atmosphere generators	49	17	•
Stock-heating furnaces	66	34	•
Salt baths	99	69	•
Induction heating units	35	11	•
Baking and drying ovens	165	67	•
Flame-hardening units	43	20	•
CLEANING AND FINISHING	756	375	19
Cleaning Equipment	617	310	•
Barrel finishing machines	187	74	•
Shot and abrasive blast	89	33	•
Parts washing machines (incl degreasers)	287	173	•
Pickling machines	54	30	•
Plating Equipment	139	65	10
Machines	57	28	•
Barrels	82	37	10
INDUSTRIAL TRUCKS (Power-Driven)	2,468	432	•
Lift (rider-type)	1,423	242	•
Truck-tractor	579	95	•
Powered hand trucks	354	65	•
Crane trucks	112	30	•
OTHER SHOP EQUIPMENT	564	152	•
Balancing Machines	67	19	•
Air Compressors	459	131	•
Gear-Checking Machines	38	•	•

Aircraft Engines, Propellers, Parts

695 plants — 388,176 employees

	Total Units	10 yr & over	Over 20 yr
METAL CUTTING	116,076	50%	3%
METAL FORMING	15,247	49	6
OTHER EQUIPMENT	27,189	36	1
TOTAL	158,512	48	3

Typical Products: Aircraft engines and engine parts; propellers and propeller parts; aircraft parts by firms that do not assemble complete aircraft. Repair work on aircraft and engines is included in Aircraft-Maintenance Table elsewhere (SIC 3722, 3723, 3729)

◆ – Less than 10

	TOTAL	10-20 YEARS	OVER 20 YR
METAL-CUTTING MACHINES	116,076	54,859	3,628
Boring Machines	6,201	3,043	255
Horizontal boring, drilling, & milling	1,566	823	61
Vertical boring mills incl vert turret lathes	1,738	777	97
Precision, horizontal and vertical	1,529	852	52
Jig boring, horizontal and vertical	1,269	528	39
Other (except boring lathes)	99	63	◆
Broaching Machines	793	364	26
Horizontal internal or combination	287	153	◆
Horizontal surface	19	11	◆
Vertical internal	182	103	13
Vertical surface or combination	270	97	◆
Continuous horizontal & vertical	25	◆	◆
Other (incl rotary surface)	10	◆	◆
Contour Sawing and Filing	1,331	641	34
Cutoff Machines	5,178	2,309	118
Bandsaw (incl friction)	2,280	875	31
Abrasive disk	1,084	633	14
Hacksaws	1,232	601	66
Circular (incl friction)	511	196	◆
Other	71	◆	◆
Drilling Machines	24,150	10,572	564
Sensitive	4,119	2,050	93
Upright: Single-spindle	11,115	4,647	253
Gang	3,789	1,722	78
Radial	2,470	1,057	79
Multi-spindle cluster, adjustable and fixed center	1,463	724	15
Automatic	285	77	◆
Unit head & way type (not dial)	149	40	12
Deep-hole drills	188	59	10
Other (not incl special machines)	572	196	24
Gear Cutting and Finishing Machines	2,579	1,616	170
Hobbing machines, gear	778	436	86
Shapers, gear	880	616	58
Form-milling type (spur and bevel)	32	21	◆
Bevel-gear cutters (not planer)	214	120	◆
Grinders, gear tooth	302	179	14
Shavers, gear tooth	217	126	◆
Burnishing and lapping	81	74	◆
Chamfering, tooth pointing, tooth rounding	33	22	◆
Other	42	22	◆
Grinding Machines	24,426	12,417	696
External cylindrical: Plain	2,287	1,495	103
Universal	1,151	516	68
Internal cylindrical	1,811	1,072	69
Centerless: External	841	416	21
Internal	83	45	◆
Surface: Rotary-table type	1,131	680	11
Reciprocating type	2,092	928	133
Disk, horizontal and vertical	1,553	742	23
Tool and cutter (incl drill)	4,338	2,204	90
Bench, floorstand, and snag	6,185	3,314	146
Jig grinders	118	57	◆
Contour grinders	291	40	◆
Abrasive belt (not polishing)	1,900	596	38
Other (except thread grinders)	645	312	◆
Honing and Lapping	1,948	724	39
Honing: Internal (incl combination)	1,174	421	◆
External and surface	95	24	◆
Lapping: Surface	286	138	◆
Cylindrical	218	60	32
Other (incl combination hone-lap)	175	81	◆
Lathes	23,337	11,125	780
Bench, floor, ti-dy (incl turret attachment)	3,847	1,917	65
Engine, heavy-duty: Standard	4,641	2,159	312
Toolroom	2,558	1,023	101
Manufacturing and gap	636	189	21
Tracer	590	56	◆
Turret lathes: Ram type	5,475	2,703	102
Saddle type	2,348	1,465	43
Auto chucking & between centers (single spindle)	876	364	17
Automatic chucking (multi-spindle)	330	206	17
Automatic screw machines (single spindle)	1,213	642	◆
Automatic bar machines (multi-spindle)	474	332	81
Other (except spinning lathes)	349	49	11
Milling Machines	15,657	6,990	579
Bench type	271	134	◆
Hand	1,681	1,050	31
Knee-type: Horizontal (plain & universal)	5,437	2,725	238
Vertical	3,709	1,607	61
Automatic & manufacturing	501	265	14
Ram type, swivel head	681	198	◆
Bed (Lincoln) type, incl automatic rise and fall	622	294	28
Planer type (incl skin and spar)	198	83	11
Profilers, duplicators, diesinkers, engravers	2,151	480	155
Other (except thread milling)	406	154	24
Planers	349	140	78
Double housing	195	86	48
Openside and other	154	54	30
Pipe Cutting and Threading Machines	393	234	14
Polishing and Buffing Machines	4,477	2,132	74
Polishing stands (bench and floor)	1,724	835	30
Speed lathes	1,048	649	16
Abrasive-belt, disk, drum	1,399	544	15
Other	306	104	13
Shapers	1,363	755	170
Horizontal	1,152	626	154
Vertical, incl slotters & keyseaters	211	129	16
Threading (except pipe)	2,950	1,908	24
Tapping	1,279	735	◆
Hobbing and milling	428	326	◆
Die type	241	135	◆
Grinders, thread	759	554	◆
Rolling machines, thread	171	117	◆
Other	72	41	◆

	TOTAL	10-20 YEARS	OVER 20 YR
Electro-Erosion Machines (exc Tap disintegrators)	120	◆	◆
Ultrasonic Cutting Machines	30	◆	◆
Special Multi-Station Machines	643	54	◆
In-line and transfer	32	◆	◆
Dial or rotary table	307	32	◆
Automatic assembly (all types)	304	22	◆
Other Metal-Cutting Machines	151	28	◆
METAL-FORMING MACHINES	15,247	6,540	981
Bending and Forming Machines (Power)	2,327	846	95
Bending rolls, sheet and plate	620	225	43
Bending rolls, bars and shapes	243	104	12
Bending brakes	737	217	23
Rotary bending and forming machines	253	119	11
Bending machines, pipe, bar, and shapes	494	181	◆
Wire and Strip Forming Machines	304	59	◆
Hydraulic Presses	2,844	1,665	78
Vertical, single-action	1,638	841	63
Vertical, double and triple action	213	40	12
Horizontal	533	427	◆
Extrusion (from hot billets)	18	18	◆
Other (incl stretch and hydro-pneumatic)	442	339	◆
Pneumatic Presses (except hydro-pneumatic)	397	245	◆
Mechanical Presses (Power)	4,305	1,604	645
Inclinable, single-action (incl inclined)	2,464	945	374
Vertical, single-action: Straight-side (incl arch)	751	328	144
Vertical, single-action: Gap or C-frame	326	122	44
Vertical, single-action: Adjust. bed and horning	154	51	◆
Double and triple action	197	47	17
Dieing machines	111	30	◆
Horizontal (incl bulldozers)	44	40	◆
Multiple transfer (incl eyeletting)	36	11	◆
Other	222	30	51
Punching and Shearing Machines	1,957	805	88
Punching machines (incl turret)	392	139	◆
Plate and sheet shears	719	239	36
Bar and angle shears	72	35	◆
Rotary shears, incl slitters	310	146	16
Nibbling machines	435	236	26
Other	29	10	◆
Forging Machinery (except presses)	681	478	22
Hammers, steam or air	131	69	◆
Hammers, mechanical (incl drop and helve)	345	238	16
Forging machines (headers) and rolls	28	15	◆
Swaging machines	177	156	◆
Other	◆	◆	◆
Riveting Machines (not portable)	2,227	772	46
Squeeze type	1,594	381	11
Rotary-vibrating type	157	127	◆
Spinning type	185	107	12
Hammer type	291	157	14
Die Casting Machines	127	22	◆
Hot chamber	45	22	◆
Cold chamber	82	◆	◆
Plastics Molding Machines	78	44	◆
Injection	30	◆	◆
Compression	48	37	◆
Extrusion	◆	◆	◆
WELDING EQUIPMENT	9,877	2,832	138
Electric Welding Equipment	9,652	2,749	134
Power source: Motor-generator set	3,348	1,245	75
Transformer and rectifier	1,962	372	◆
Arc-weld machines (not hand) incl automatic	1,074	398	◆
Resistance welders: Spot	2,249	458	39
Gun (not hand)	275	16	◆
Seam	594	224	◆
Butt and flash	150	36	12
Gas Welding Machines (not hand)	82	45	◆
Flame Cutting Machines (not hand)	143	38	◆
HEATING EQUIPMENT	6,123	2,726	102
Heat-treating furnaces	3,073	1,617	52
Atmosphere generators	414	96	◆
Stock-heating furnaces	247	61	15
Salt baths	432	213	32
Induction heating units	497	104	◆
Baking and drying ovens	1,371	608	◆
Flame-hardening units	89	27	◆
CLEANING AND FINISHING	4,647	1,884	27
Cleaning Equipment	3,736	1,376	25
Barrel finishing machines	1,265	489	11
Shot and abrasive blast	838	384	◆
Parts washing machines (incl degreasers)	1,501	441	◆
Pickling machines	132	62	◆
Plating Equipment	911	508	◆
Machines	599	417	◆
Barrels	312	91	◆
INDUSTRIAL TRUCKS (Power-Driven)	3,225	793	◆
Lift (rider-type)	1,765	488	◆
Truck-tractor	398	48	◆
Powered hand trucks	960	233	◆
Crane trucks	102	24	◆
OTHER SHOP EQUIPMENT	3,317	1,303	39
Balancing Machines	458	176	11
Air Compressors	2,159	825	16
Gear-Checking Machines	700	302	12

Precision Mechanisms

Typical Products: Engineering, laboratory, and scientific instruments; mechanical measuring and controlling instruments; automatic temperature controls; optical instruments; surgical, medical, dental, and ophthalmic instruments and goods; photographic equipment; watches, clocks, and parts (SIC 38)

878 plants — 269,740 employees

	Total Units	10 yr & over	Over 20 yr
METAL CUTTING	81,216	59%	15%
METAL FORMING	16,875	60	21
OTHER EQUIPMENT	16,077	43	6
TOTAL	114,168	57	15

• – Less than 10

	TOTAL	10-20 YEARS	OVER 20 YR
METAL-CUTTING MACHINES	**81,216**	**35,807**	**12,387**
Boring Machines	**1,241**	**522**	**66**
Horizontal boring, drilling, & milling	304	124	22
Vertical boring mills incl vert turret lathes	160	73	17
Precision, horizontal and vertical	235	136	•
Jig boring, horizontal and vertical	520	177	20
Other (except boring lathes)	22	12	•
Broaching Machines	**262**	**224**	**•**
Horizontal internal or combination	47	32	•
Horizontal surface	38	36	•
Vertical internal	41	33	•
Vertical surface or combination	23	12	•
Continuous horizontal & vertical	•	•	•
Other (incl rotary surface)	109	107	•
Contour Sawing and Filing	**823**	**355**	**72**
Cutoff Machines	**3,234**	**1,332**	**266**
Bandsaw (incl friction)	1,235	503	75
Abrasive disk	630	250	39
Hacksaws	960	412	127
Circular (incl friction)	329	118	17
Other	80	49	•
Drilling Machines	**20,731**	**9,080**	**2,213**
Sensitive	4,633	2,482	442
Upright: Single-spindle	10,076	4,185	1,037
Gang	3,634	1,437	432
Radial	558	202	73
Multi-spindle cluster, adjustable and fixed center	1,057	467	166
Automatic	218	35	•
Unit head & way type (not dial)	157	14	•
Deep-hole drills	28	13	•
Other (not incl special machines)	370	245	57
Gear Cutting and Finishing Machines	**1,889**	**1,314**	**156**
Hobbing machines, gear	1,199	884	69
Shapers, gear	165	109	11
Form-milling type (spur and bevel)	201	136	55
Bevel-gear cutters (not planer)	102	73	•
Grinders, gear tooth	62	35	•
Shavers, gear tooth	65	47	•
Burnishing and lapping	83	27	•
Chamfering, tooth pointing, tooth rounding	•	•	•
Other	12	•	•
Grinding Machines	**12,730**	**5,861**	**1,552**
External cylindrical: Plain	996	485	151
Universal	451	227	63
Internal cylindrical	754	113	32
Centerless: External	321	199	12
Internal	•	•	•
Surface: Rotary-table type	435	160	44
Reciprocating type	1,908	877	744
Disk, horizontal and vertical	454	235	63
Tool and cutter (incl drill)	1,939	854	201
Bench, floorstand, and snag	3,820	1,839	320
Jig grinders	64	29	•
Contour grinders	72	47	•
Abrasive belt (not polishing)	1,368	715	57
Other (except thread grinders)	647	86	357
Honing and Lapping	**923**	**328**	**38**
Honing: Internal (incl combination)	380	129	15
External and surface	57	15	•
Lapping: Surface	379	128	19
Cylindrical	84	44	•
Other (incl combination hone-lap)	23	12	•
Lathes	**21,635**	**9,533**	**4,970**
Bench, floor, lt-dy (incl turret attachment)	6,517	3,117	1,591
Engine, heavy-duty: Standard	2,408	1,118	385
Toolroom	2,402	921	346
Manufacturing and gap	210	79	14
Tracer	144	26	•
Turret lathes: Ram type	2,826	1,294	541
Saddle type	943	409	155
Auto chucking & between centers (single spindle)	247	28	•
Automatic chucking (multi-spindle)	77	35	14
Automatic screw machines (single spindle)	5,244	2,223	1,805
Automatic bar machines (multi-spindle)	292	132	•
Other (except spinning lathes)	325	151	110
Milling Machines	**8,975**	**3,560**	**1,830**
Bench type	917	300	269
Hand	1,297	449	443
Knee-type: Horizontal (plain & universal)	2,576	1,224	530
Vertical	1,857	685	101
Automatic & manufacturing	655	347	116
Ram type, swivel head	354	120	•
Bed (Lincoln) type, incl automatic rise and fall	261	16	•
Planer type (incl skin and spar)	29	•	•
Profilers, duplicators, diesinkers, engravers	446	212	39
Other (except thread milling)	583	202	317
Planers	**124**	**49**	**60**
Double housing	50	•	38
Openside and other	74	42	22
Pipe Cutting and Threading Machines	**278**	**152**	**23**
Polishing and Buffing Machines	**5,230**	**2,228**	**560**
Polishing stands (bench and floor)	2,241	900	236
Speed lathes	1,203	621	245
Abrasive-belt, disk, drum	1,163	478	52
Other	623	229	27
Shapers	**844**	**458**	**207**
Horizontal	784	413	200
Vertical, incl slotters & keyseaters	60	45	•
Threading (except pipe)	**1,638**	**690**	**324**
Tapping	1,041	396	144
Hobbing and milling	69	25	27
Die type	15	•	•
Grinders, thread	178	151	11
Rolling machines, thread	90	12	53
Other	245	65	88

	TOTAL	10-20 YEARS	OVER 20 YR
Electro-Erosion Machines (exc Tap disintegrators)	**28**	**•**	**•**
Ultrasonic Cutting Machines	**•**	**•**	**•**
Special Multi-Station Machines	**445**	**48**	**•**
In-line and transfer	47	•	•
Dial or rotary table	327	46	•
Automatic assembly (all types)	71	•	•
Other Metal-Cutting Machines	**183**	**105**	**40**
METAL-FORMING MACHINES	**16,875**	**6,539**	**3,544**
Bending and Forming Machines (Power)	**1,485**	**652**	**164**
Bending rolls, sheet and plate	459	266	54
Bending rolls, bars and shapes	47	24	15
Bending brakes	730	272	84
Rotary bending and forming machines	60	21	•
Bending machines, pipe, bar, and shapes	189	69	•
Wire and Strip Forming Machines	**138**	**29**	**66**
Hydraulic Presses	**1,038**	**288**	**77**
Vertical, single-action	904	230	63
Vertical, double and triple action	86	49	•
Horizontal	29	•	•
Extrusion (from hot billets)	•	•	•
Other (incl stretch and hydro-pneumatic)	19	•	10
Pneumatic Presses (except hydro-pneumatic)	**842**	**168**	**24**
Mechanical Presses (Power)	**8,089**	**3,583**	**2,453**
Inclinable, single-action (incl inclined)	4,281	1,595	1,207
Vertical, single-action: Straight-side (incl arch)	978	467	310
Vertical, single-action: Gap or C-frame	1,352	694	439
Vertical, single-action: Adjust. bed and horning	82	74	•
Double and triple action	24	15	•
Dieing machines	84	55	26
Horizontal (incl bulldozers)	27	17	•
Multiple transfer (incl eyeletting)	727	543	163
Other	534	123	297
Punching and Shearing Machines	**1,485**	**555**	**203**
Punching machines (incl turret)	502	190	61
Plate and sheet shears	620	229	82
Bar and angle shears	56	10	16
Rotary shears, incl slitters	58	21	28
Nibbling machines	116	47	•
Other	133	58	•
Forging Machinery (except presses)	**469**	**141**	**266**
Hammers, steam or air	•	•	•
Hammers, mechanical (incl drop and helve)	37	13	20
Forging machines (headers) and rolls	12	•	•
Swaging machines	395	121	221
Other	16	•	14
Riveting Machines (not portable)	**2,765**	**1,017**	**276**
Squeeze type	1,191	537	107
Rotary-vibrating type	614	160	22
Spinning type	406	148	89
Hammer type	554	172	58
Die Casting Machines	**12**	**•**	**•**
Hot chamber	•	•	•
Cold chamber	•	•	•
Plastics Molding Machines	**552**	**106**	**15**
Injection	206	29	•
Compression	334	77	15
Extrusion	12	•	•
WELDING EQUIPMENT	**3,858**	**1,756**	**231**
Electric Welding Equipment	**3,673**	**1,663**	**220**
Power source: Motor-generator set	550	287	30
Transformer and rectifier	883	337	79
Arc-weld machines (not hand) incl automatic	317	202	•
Resistance welders: Spot	1,683	737	99
Gun (not hand)	110	50	•
Seam	43	12	•
Butt and flash	87	38	•
Gas Welding Machines (not hand)	**105**	**55**	**•**
Flame Cutting Machines (not hand)	**80**	**38**	**•**
HEATING EQUIPMENT	**4,772**	**1,403**	**421**
Heat-treating furnaces	1,488	563	226
Atmosphere generators	159	38	15
Stock-heating furnaces	82	20	11
Salt baths	553	236	36
Induction heating units	397	76	•
Baking and drying ovens	1,971	418	112
Flame-hardening units	122	52	21
CLEANING AND FINISHING	**3,962**	**1,558**	**340**
Cleaning Equipment	**3,256**	**1,238**	**307**
Barrel finishing machines	1,500	645	198
Shot and abrasive blast	454	162	69
Parts washing machines (incl degreasers)	1,261	431	36
Pickling machines	41	•	•
Plating Equipment	**706**	**320**	**33**
Machines	245	150	11
Barrels	461	170	22
INDUSTRIAL TRUCKS (Power-Driven)	**1,196**	**297**	**13**
Lift (rider-type)	733	196	12
Truck-tractor	37	19	•
Powered hand trucks	374	79	•
Crane trucks	11	•	•
OTHER SHOP EQUIPMENT	**2,330**	**884**	**50**
Balancing Machines	**172**	**69**	**•**
Air Compressors	**1,928**	**739**	**43**
Gear-Checking Machines	**230**	**76**	**•**

Shipbuilding, Ordnance, and Railroad Equipment

459 plants — 343,792 employees

	Total Units	10 yr & over	Over 20 yr
METAL CUTTING	81,543	72%	19%
METAL FORMING	10,744	78	30
OTHER EQUIPMENT	40,074	61	8
TOTAL	132,361	69	16

* — Less than 10

Typical Products: Ordnance and accessories, including guns, ammunition, tanks, missiles, fire-control equipment, and small arms; ship and boat building and repairing; locomotives and parts; railroad and street cars (repair work on locomotives and cars is included in Railroad-Maintenance Table elsewhere) (SIC 19, 373, 374)

	TOTAL	10-20 YEARS	OVER 20 YR
METAL-CUTTING MACHINES	81,543	43,224	15,251
Boring Machines	3,975	2,083	663
Horizontal boring, drilling, & milling	1,707	906	325
Vertical boring mills incl vert turret lathes	1,578	914	290
Precision, horizontal and vertical	284	115	14
Jig boring, horizontal and vertical	302	122	10
Other (except boring lathes)	104	26	24
Broaching Machines	503	265	67
Horizontal internal or combination	313	180	34
Horizontal surface	30	*	*
Vertical internal	44	23	*
Vertical surface or combination	91	46	13
Continuous horizontal & vertical	*	*	*
Other (incl rotary surface)	25	10	*
Contour Sawing and Filing	721	439	40
Cutoff Machines	4,070	2,303	466
Bandsaw (incl friction)	1,108	626	118
Abrasive disk	894	454	65
Hacksaws	1,539	953	172
Circular (incl friction)	328	163	81
Other	201	107	30
Drilling Machines	13,183	6,804	2,948
Sensitive	5,398	2,751	1,311
Upright: Single-spindle	3,327	1,754	642
Gang	1,171	593	190
Radial	2,176	1,298	381
Multi-spindle cluster, adjustable and fixed center	227	100	59
Automatic	27	12	*
Unit head & way type (not dial)	108	48	*
Deep-hole drills	542	155	305
Other (not incl special machines)	207	93	55
Gear Cutting and Finishing Machines	1,199	718	137
Hobbing machines, gear	414	264	40
Shapers, gear	333	202	46
Form-milling type (spur and bevel)	102	64	27
Bevel-gear cutters (not planer)	155	96	11
Grinders, gear tooth	99	29	*
Shavers, gear tooth	47	28	*
Burnishing and lapping	13	*	*
Chamfering, tooth pointing, tooth rounding	14	*	*
Other	22	20	*
Grinding Machines	17,318	9,751	2,718
External cylindrical: Plain	1,098	592	203
Universal	601	328	55
Internal cylindrical	557	278	67
Centerless: External	185	85	*
Internal	62	24	14
Surface: Rotary-table type	525	297	57
Reciprocating type	1,699	833	187
Disk, horizontal and vertical	337	162	87
Tool and cutter (incl drill)	3,688	2,032	564
Bench, floorstand, and snag	6,944	4,223	1,332
Jig grinders	354	283	18
Contour grinders	44	17	*
Abrasive belt (not polishing)	337	149	11
Other (except thread grinders)	887	448	114
Honing and Lapping	688	306	54
Honing: Internal (incl combination)	411	210	17
External and surface	35	20	*
Lapping: Surface	75	33	18
Cylindrical	55	31	*
Other (incl combination hone-lap)	24	12	*
Lathes	17,759	9,171	3,285
Bench, floor, lt-dy (incl turret attachment)	2,974	1,509	570
Engine, heavy-duty: Standard	5,172	2,609	1,131
Toolroom	2,762	1,421	609
Manufacturing and gap	206	52	29
Tracer	283	119	50
Turret lathes: Ram type	1,739	927	289
Saddle type	1,430	716	172
Auto chucking & between centers (single spindle)	947	638	62
Automatic chucking (multi-spindle)	145	92	21
Automatic screw machines (single spindle)	1,149	568	150
Automatic bar machines (multi-spindle)	183	98	15
Other (except spinning lathes)	769	422	187
Milling Machines	13,097	6,473	3,005
Bench type	477	252	81
Hand	1,072	670	318
Knee-type: Horizontal (plain & universal)	3,521	1,904	463
Vertical	2,123	1,066	244
Automatic & manufacturing	1,032	456	229
Ram type, swivel head	85	21	36
Bed (Lincoln) type, incl automatic rise and fall	1,945	840	651
Planer type (incl skin and spar)	147	65	52
Profilers, duplicators, diesinkers, engravers	1,039	696	75
Other (except thread milling)	1,656	503	856
Planers	705	367	232
Double housing	389	193	142
Openside and other	316	174	90
Pipe Cutting and Threading Machines	1,112	675	159
Polishing and Buffing Machines	2,762	1,588	365
Polishing stands (bench and floor)	1,136	702	105
Speed lathes	705	411	70
Abrasive-belt, disk, drum	765	406	112
Other	156	69	78
Shapers	2,676	1,331	799
Horizontal	1,751	857	551
Vertical, incl slotters & keyseaters	925	474	248
Threading (except pipe)	1,904	764	310
Tapping	514	256	100
Hobbing and milling	588	304	77
Die type	138	80	43
Grinders, thread	141	91	*
Rolling machines, thread	14	*	*
Other	109	28	81

	TOTAL	10-20 YEARS	OVER 20 YR
Electro-Erosion Machines (exc Tap disintegrators)	*	*	*
Ultrasonic Cutting Machines	*	*	*
Special Multi-Station Machines	309	168	*
In-line and transfer	*	*	*
Dial or rotary table	30	*	*
Automatic assembly (all types)	277	161	*
Other Metal-Cutting Machines	36	18	*
METAL-FORMING MACHINES	10,744	5,217	3,197
Bending and Forming Machines (Power)	1,959	904	488
Bending rolls, sheet and plate	713	281	233
Bending rolls, bars and shapes	84	43	35
Bending brakes	513	270	80
Rotary bending and forming machines	212	79	50
Bending machines, pipe, bar, and shapes	437	231	90
Wire and Strip Forming Machines	199	62	103
Hydraulic Presses	1,739	794	451
Vertical, single-action	1,144	564	242
Vertical, double and triple action	215	61	107
Horizontal	169	73	75
Extrusion (from hot billets)	*	*	*
Other (incl stretch and hydro-pneumatic)	211	96	27
Pneumatic Presses (except hydro-pneumatic)	328	161	99
Mechanical Presses (Power)	1,840	978	498
Inclinable, single-action (incl inclined)	623	361	127
Vertical, single-action: Straight-side (incl arch)	336	151	105
Vertical, single-action: Gap or C-frame	320	181	94
Vertical, single-action: Adjust. bed and horning	43	16	22
Double and triple action	93	75	*
Dieing machines	83	17	61
Horizontal (incl bulldozers)	168	90	47
Multiple transfer (incl eyeletting)	88	52	21
Other	86	35	14
Punching and Shearing Machines	3,539	1,837	1,088
Punching machines (incl turret)	1,181	524	473
Plate and sheet shears	1,428	855	330
Bar and angle shears	353	131	159
Rotary shears, incl slitters	230	130	67
Nibbling machines	192	88	25
Other	155	109	34
Forging Machinery (except presses)	772	291	400
Hammers, steam or air	377	125	209
Hammers, mechanical (incl drop and helve)	159	53	104
Forging machines (headers) and rolls	124	48	47
Swaging machines	82	59	21
Other	30	*	19
Riveting Machines (not portable)	342	183	65
Squeeze type	172	97	49
Rotary-vibrating type	37	16	*
Spinning type	36	11	*
Hammer type	97	59	*
Die Casting Machines	15	*	*
Hot chamber	15	*	*
Cold chamber	*	*	*
Plastics Molding Machines	11	*	*
Injection	*	*	*
Compression	*	*	*
Extrusion	*	*	*
WELDING EQUIPMENT	22,973	12,802	845
Electric Welding Equipment	21,298	11,696	777
Power source: Motor-generator set	9,926	6,808	602
Transformer and rectifier	6,741	2,309	64
Arc-weld machines (not hand) incl automatic	3,309	2,050	14
Resistance welders: Spot	509	270	42
Gun (not hand)	658	202	*
Seam	67	28	14
Butt and flash	80	29	34
Gas Welding Machines (not hand)	162	54	*
Flame Cutting Machines (not hand)	1,521	1,052	67
HEATING EQUIPMENT	5,316	2,804	1,142
Heat-treating furnaces	2,320	1,368	525
Atmosphere generators	26	*	*
Stock-heating furnaces	873	371	313
Salt baths	303	156	26
Induction heating units	260	123	*
Baking and drying ovens	1,449	758	247
Flame-hardening units	85	22	29
CLEANING AND FINISHING	3,470	1,963	213
Cleaning Equipment	3,014	1,905	195
Barrel finishing machines	344	182	21
Shot and abrasive blast	1,389	1,030	41
Parts washing machines (incl degreasers)	1,205	638	126
Pickling machines	76	55	*
Plating Equipment	456	58	18
Machines	348	26	*
Barrels	108	32	11
INDUSTRIAL TRUCKS (Power-Driven)	6,781	2,823	716
Lift (rider-type)	1,873	493	78
Truck-tractor	711	201	19
Powered hand trucks	3,380	1,674	540
Crane trucks	817	455	79
OTHER SHOP EQUIPMENT	1,534	815	151
Balancing Machines	241	120	19
Air Compressors	1,133	602	116
Gear-Checking Machines	160	93	16

Forge Shops, Foundries, Miscellaneous

Typical Products: Iron and steel castings, nonferrous castings, and iron, steel, and nonferrous forgings; machine shops, jobbing and repair; machinery and parts, not elsewhere classified; metal furniture, household and office; miscellaneous manufacturing industries (jewelry, toys, pens, morticians' goods, signs, etc.) **(SIC 332, 336, 339, 25, 359, 39)**

4643 plants — 755,806 employees

	Total Units	10 yr & over	Over 20 yr
METAL CUTTING	182,358	59%	16%
METAL FORMING	63,570	63	21
OTHER EQUIPMENT	68,222	53	11
TOTAL	314,150	58	16

• – Less than 10

	TOTAL	10-20 YEARS	OVER 20 YR
METAL-CUTTING MACHINES	182,358	78,390	28,573
Boring Machines	6,080	2,328	1,483
Horizontal boring, drilling, & milling	1,980	812	526
Vertical boring mills incl vert turret lathes	2,310	1,015	848
Precision, horizontal and vertical	623	259	36
Jig boring, horizontal and vertical	975	172	21
Other (except boring lathes)	184	70	52
Broaching Machines	720	365	189
Horizontal internal or combination	275	127	90
Horizontal surface	125	23	67
Vertical internal	136	90	12
Vertical surface or combination	152	94	20
Continuous horizontal & vertical	•	•	•
Other (incl rotary surface)	29	29	•
Contour Sawing and Filing	2,162	931	96
Cutoff Machines	13,339	5,514	1,561
Bandsaw (incl friction)	5,497	2,252	530
Abrasive disk	1,893	757	99
Hacksaws	3,923	1,892	665
Circular (incl friction)	1,675	540	176
Other	351	73	91
Drilling Machines	36,084	14,120	4,531
Sensitive	4,261	1,672	306
Upright: Single-spindle	20,698	8,241	2,440
Gang	3,529	1,248	546
Radial	3,421	1,451	820
Multi-spindle cluster, adjustable and fixed center	1,299	455	159
Automatic	560	149	•
Unit head & way type (not dial)	766	311	•
Deep-hole drills	246	69	48
Other (not incl special machines)	1,304	524	212
Gear Cutting and Finishing Machines	1,722	744	389
Hobbing machines, gear	542	230	92
Shapers, gear	839	424	142
Form-milling type (spur and bevel)	117	35	78
Bevel-gear cutters (not planer)	43	•	27
Grinders, gear tooth	35	•	•
Shavers, gear tooth	51	•	20
Burnishing and lapping	41	21	•
Chamfering, tooth pointing, tooth rounding	•	•	•
Other	45	10	21
Grinding Machines	37,368	17,452	4,851
External cylindrical: Plain	2,482	1,430	463
Universal	898	426	75
Internal cylindrical	926	562	87
Centerless: External	848	492	59
Internal	106	80	•
Surface: Rotary-table type	1,831	700	299
Reciprocating type	5,154	2,237	530
Disk, horizontal and vertical	1,799	802	436
Tool and cutter (incl drill)	5,963	2,426	703
Bench, floorstand, and snag	12,570	6,460	1,873
Jig grinders	159	16	14
Contour grinders	507	376	•
Abrasive belt (not polishing)	2,772	982	135
Other (except thread grinders)	1,353	463	175
Honing and Lapping	2,226	954	207
Honing: Internal (incl combination)	1,193	540	37
External and surface	104	63	•
Lapping: Surface	469	201	21
Cylindrical	316	130	27
Other (incl combination hone-lap)	144	20	116
Lathes	34,463	15,051	7,425
Bench, floor, ft-dy (incl turret attachment)	7,274	3,176	917
Engine, heavy-duty: Standard	9,105	3,723	3,438
Toolroom	5,168	2,303	577
Manufacturing and gap	835	353	285
Tracer	337	51	•
Turret lathes: Ram type	4,524	2,250	678
Saddle type	2,136	1,073	415
Auto chucking & between centers (single spindle)	666	232	100
Automatic chucking (multi-spindle)	358	178	36
Automatic screw machines (single spindle)	2,502	931	574
Automatic bar machines (multi-spindle)	762	394	114
Other (except spinning lathes)	796	387	282
Milling Machines	19,998	8,486	3,632
Bench type	1,060	425	212
Hand	2,129	993	551
Knee-type: Horizontal (plain & universal)	6,325	2,987	1,490
Vertical	4,936	1,912	426
Automatic & manufacturing	1,099	573	237
Ram type, swivel head	904	162	47
Bed (Lincoln) type, incl automatic rise and fall	595	319	76
Planer type (incl skin and spar)	261	82	128
Profilers, duplicators, diesinkers, engravers	2,280	873	408
Other (except thread milling)	409	160	57
Planers	1,866	631	1,078
Double housing	1,294	395	841
Openside and other	572	236	237
Pipe Cutting and Threading Machines	1,398	525	194
Polishing and Buffing Machines	14,941	7,305	889
Polishing stands (bench and floor)	9,362	4,558	290
Speed lathes	1,801	1,162	263
Abrasive-belt, disk, drum	3,332	1,418	306
Other	446	167	30
Shapers	4,864	2,197	1,671
Horizontal	4,176	1,948	1,398
Vertical, incl slotters & keyseaters	688	249	273
Threading (except pipe)	3,137	1,189	283
Tapping	1,678	586	114
Hobbing and milling	211	95	29
Die type	334	142	63
Grinders, thread	422	244	•
Rolling machines, thread	183	109	34
Other	309	13	43

	TOTAL	10-20 YEARS	OVER 20 YR
Electro-Erosion Machines (exc Tap disintegrators)	50	•	•
Ultrasonic Cutting Machines	25	•	•
Special Multi-Station Machines	1,121	300	•
In-line and transfer	425	121	•
Dial or rotary table	359	125	•
Automatic assembly (all types)	337	54	•
Other Metal-Cutting Machines	794	289	94
METAL-FORMING MACHINES	63,570	26,480	13,537
Bending and Forming Machines (Power)	9,343	2,817	1,008
Bending rolls, sheet and plate	963	354	281
Bending rolls, bars and shapes	268	132	72
Bending brakes	4,595	1,925	537
Rotary bending and forming machines	277	34	37
Bending machines, pipe, bar, and shapes	1,240	372	81
Wire and Strip Forming Machines	1,716	701	197
Hydraulic Presses	3,075	1,027	616
Vertical, single-action	2,245	840	357
Vertical, double and triple action	317	85	51
Horizontal	379	74	204
Extrusion (from hot billets)	41	•	•
Other (incl stretch and hydro-pneumatic)	93	27	•
Pneumatic Presses (except hydro-pneumatic)	391	147	•
Mechanical Presses (Power)	31,194	13,452	7,763
Inclinable, single-action (incl inclined)	17,072	8,190	3,344
Vertical, single-action: Straight-side (incl arch)	6,169	2,142	2,840
Vertical, single-action: Gap or C-frame	3,837	1,504	943
Vertical, single-action: Adjust. bed and horning	742	404	45
Double and triple action	620	310	125
Dieing machines	212	16	11
Horizontal (incl bulldozers)	137	38	95
Multiple transfer (incl eyeletting)	371	213	88
Other	2,034	635	272
Punching and Shearing Machines	8,015	3,640	1,731
Punching machines (incl turret)	1,409	698	227
Plate and sheet shears	3,349	1,463	537
Bar and angle shears	678	240	220
Rotary shears, incl slitters	639	289	116
Nibbling machines	555	224	98
Other	1,385	726	533
Forging Machinery (except presses)	4,164	1,584	1,871
Hammers, steam or air	1,477	584	579
Hammers, mechanical (incl drop and helve)	1,350	386	810
Forging machines (headers) and rolls	529	202	191
Swaging machines	647	378	243
Other	161	34	48
Riveting Machines (not portable)	5,538	2,490	309
Squeeze type	2,138	790	48
Rotary-vibrating type	322	144	43
Spinning type	1,200	908	71
Hammer type	1,878	648	147
Die Casting Machines	1,326	322	35
Hot chamber	847	222	19
Cold chamber	479	100	16
Plastics Molding Machines	808	300	•
Injection	393	76	•
Compression	415	224	•
Extrusion	•	•	•
WELDING EQUIPMENT	21,199	10,193	1,094
Electric Welding Equipment	20,128	9,710	1,056
Power source: Motor-generator set	5,890	3,242	243
Transformer and rectifier	3,808	1,286	78
Arc-weld machines (not hand) incl automatic	1,672	788	20
Resistance welders: Spot	7,636	3,936	644
Gun (not hand)	519	202	11
Seam	181	91	•
Butt and flash	422	165	54
Gas Welding Machines (not hand)	319	158	•
Flame Cutting Machines (not hand)	732	325	32
HEATING EQUIPMENT	14,183	6,649	2,193
Heat-treating furnaces	5,453	2,669	988
Atmosphere generators	712	215	280
Stock-heating furnaces	2,877	1,310	605
Salt baths	1,470	762	68
Induction heating units	602	131	•
Baking and drying ovens	2,880	1,468	233
Flame-hardening units	189	94	11
CLEANING AND FINISHING	16,513	6,119	2,496
Cleaning Equipment	12,654	4,521	2,307
Barrel finishing machines	7,508	2,670	1,989
Shot and abrasive blast	2,575	983	222
Parts washing machines (incl degreasers)	2,382	769	77
Pickling machines	189	99	19
Plating Equipment	3,859	1,598	189
Machines	1,753	415	118
Barrels	2,106	1,183	71
INDUSTRIAL TRUCKS (Power-Driven)	7,392	2,538	432
Lift (rider-type)	5,252	1,841	315
Truck-tractor	423	82	12
Powered hand trucks	1,319	523	35
Crane trucks	398	92	70
OTHER SHOP EQUIPMENT	8,935	3,518	1,009
Balancing Machines	466	227	32
Air Compressors	8,365	3,278	969
Gear-Checking Machines	104	13	•

1523 plants — 356,669 employees

	Total Units	10 yr & over	Over 20 yr
METAL CUTTING	136,832	67%	20%
METAL FORMING	36,208	65	26
OTHER EQUIPMENT	36,533	52	13
TOTAL	209,573	64	20

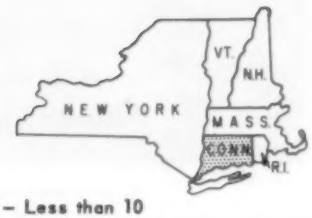
• – Less than 10

All of the states of Maine, New Hampshire, Vermont, Massachusetts, and Rhode Island

Boston

	TOTAL	10-20 YEARS	OVER 20 YR
METAL-CUTTING MACHINES	136,832	64,176	27,344
Boring Machines	3,884	1,775	746
Horizontal boring, drilling, & milling	1,305	646	242
Vertical boring mills incl vert turret lathes	1,185	569	392
Precision, horizontal and vertical	545	269	26
Jig boring, horizontal and vertical	690	211	53
Other (except boring lathes)	159	80	33
Broaching Machines	712	340	135
Horizontal internal or combination	341	143	79
Horizontal surface	32	11	•
Vertical internal	134	42	32
Vertical surface or combination	73	28	14
Continuous horizontal & vertical	•	•	•
Other (incl rotary surface)	129	116	•
Contour Sawing and Filing	1,195	509	98
Cutoff Machines	6,417	2,763	965
Bandsaw (incl friction)	2,333	958	247
Abrasive disk	1,003	345	74
Hacksaws	2,002	1,007	394
Circular (incl friction)	777	338	187
Other	302	115	63
Drilling Machines	25,769	12,074	4,594
Sensitive	6,084	3,563	840
Upright: Single-spindle	10,615	4,375	1,807
Gang	3,442	1,374	850
Radial	2,892	1,421	619
Multi-spindle cluster, adjustable and fixed center	961	473	137
Automatic	293	105	25
Unit head & way type (not dial)	114	27	37
Deep-hole drills	156	89	38
Other (not incl special machines)	1,212	647	241
Gear Cutting and Finishing Machines	2,684	1,275	786
Hobbing machines, gear	1,256	714	308
Shapers, gear	655	307	182
Form-milling type (spur and bevel)	258	84	135
Bevel-gear cutters (not planer)	167	64	61
Grinders, gear tooth	92	20	23
Shavers, gear tooth	101	52	•
Burnishing and lapping	64	14	19
Chamfering, tooth pointing, tooth rounding	27	•	13
Other	64	15	37
Grinding Machines	25,859	12,333	4,977
External cylindrical: Plain	1,940	1,120	406
Universal	882	423	179
Internal cylindrical	795	486	99
Centerless: External	480	251	54
Internal	28	22	•
Surface: Rotary-table type	1,033	517	128
Reciprocating type	3,803	1,834	493
Disk, horizontal and vertical	699	394	135
Tool and cutter (incl drill)	4,741	2,389	702
Bench, floorstand, and snag	7,960	3,924	1,534
Jig grinders	80	33	•
Contour grinders	199	81	13
Abrasive belt (not polishing)	1,488	698	44
Other (except thread grinders)	1,731	161	1,182
Honing and Lapping	1,128	512	93
Honing: Internal (incl combination)	505	196	20
External and surface	81	24	•
Lapping: Surface	261	136	35
Cylindrical	85	37	•
Other (incl combination hone-lap)	196	119	25
Lathes	32,920	15,612	7,376
Bench, floor, ft-dy (incl turret attachment)	7,615	3,190	1,871
Engine, heavy-duty: Standard	6,867	2,965	2,407
Toolroom	3,148	1,515	553
Manufacturing and gap	327	119	92
Tracer	368	61	29
Turret lathes: Ram type	3,874	2,335	396
Saddle type	1,785	975	221
Auto chucking & between centers (single spindle)	961	418	317
Automatic chucking (multi-spindle)	299	161	47
Automatic screw machines (single spindle)	5,355	2,804	975
Automatic bar machines (multi-spindle)	1,365	681	91
Other (except spinning lathes)	956	388	377
Milling Machines	16,161	7,436	3,517
Bench type	989	380	258
Hand	2,100	1,156	386
Knee-type: Horizontal (plain & universal)	5,534	2,325	1,853
Vertical	3,261	1,393	345
Automatic & manufacturing	916	533	126
Ram type, swivel head	626	211	45
Bed (Lincoln) type, incl automatic rise and fall	983	593	110
Planer type (incl skin and spar)	361	161	120
Profilers, duplicators, diesinkers, engravers	1,075	561	213
Other (except thread milling)	316	123	61
Planers	1,340	481	745
Double housing	977	328	589
Openside and other	363	153	156
Pipe Cutting and Threading Machines	890	395	132
Polishing and Buffing Machines	11,402	5,802	1,243
Polishing stands (bench and floor)	6,843	3,466	554
Speed lathes	1,565	742	506
Abrasive-belt, disk, drum	2,276	1,208	98
Other	718	386	85
Shapers	2,399	1,009	955
Horizontal	2,007	855	807
Vertical, incl slotters & keyseaters	392	154	148
Threading (except pipe)	2,993	1,497	746
Tapping	1,287	706	207
Hobbing and milling	388	217	105
Die type	360	154	145
Grinders, thread	304	254	•
Rolling machines, thread	546	133	242
Other	108	33	39

	TOTAL	10-20 YEARS	OVER 20 YR
Electro-Erosion Machines (exc Tap disintegrators)	35	•	•
Ultrasonic Cutting Machines	31	•	•
Special Multi-Station Machines	436	118	•
In-line and transfer	22	•	•
Dial or rotary table	247	84	•
Automatic assembly (all types)	167	29	•
Other Metal-Cutting Machines	577	244	133
METAL-FORMING MACHINES	36,208	14,170	9,533
Bending and Forming Machines (Power)	3,256	1,279	551
Bending rolls, sheet and plate	869	402	217
Bending rolls, bars and shapes	246	117	56
Bending brakes	1,303	519	178
Rotary bending and forming machines	463	111	45
Bending machines, pipe, bar, and shapes	375	130	57
Wire and Strip Forming Machines	1,230	280	465
Hydraulic Presses	1,790	649	372
Vertical, single-action	1,209	480	172
Vertical, double and triple action	191	63	75
Horizontal	159	24	104
Extrusion (from hot billets)	47	•	•
Other (incl stretch and hydro-pneumatic)	184	78	21
Pneumatic Presses (except hydro-pneumatic)	780	410	12
Mechanical Presses (Power)	18,016	6,768	5,099
Inclinable, single-action (incl inclined)	7,969	2,631	1,857
Vertical, single-action: Straight-side (incl arch)	2,904	1,138	1,001
Vertical, single-action: Gap or C-frame	3,132	1,009	1,390
Vertical, single-action: Adjust. bed and horning	924	500	74
Double and triple action	515	263	109
Dieing machines	70	19	22
Horizontal (incl bulldozers)	161	16	98
Multiple transfer (incl eyeletting)	1,022	673	258
Other	1,319	519	290
Punching and Shearing Machines	4,378	1,871	1,335
Punching machines (incl turret)	915	458	267
Plate and sheet shears	1,322	445	291
Bar and angle shears	370	165	95
Rotary shears, incl slitters	306	154	69
Nibbling machines	332	132	51
Other	1,133	517	562
Forging Machinery (except presses)	2,555	998	1,202
Hammers, steam or air	454	213	123
Hammers, mechanical (incl drop and helve)	1,169	342	668
Forging machines (headers) and rolls	315	112	167
Swaging machines	573	325	214
Other	44	•	30
Riveting Machines (not portable)	3,271	1,663	395
Squeeze type	1,287	827	107
Rotary-vibrating type	349	94	44
Spinning type	720	366	140
Hammer type	915	376	104
Die Casting Machines	138	12	•
Hot chamber	115	•	•
Cold chamber	23	•	•
Plastics Molding Machines	794	240	98
Injection	196	19	•
Compression	538	166	98
Extrusion	60	55	•
WELDING EQUIPMENT	14,304	5,048	1,769
Electric Welding Equipment	13,587	4,668	1,704
Power source: Motor-generator set	2,971	1,750	383
Transformer and rectifier	2,661	900	168
Arc-weld machines (not hand) incl automatic	1,365	517	65
Resistance welders: Spot	5,792	1,230	945
Gun (not hand)	196	49	•
Seam	187	101	13
Butt and flash	415	121	129
Gas Welding Machines (not hand)	180	45	12
Flame Cutting Machines (not hand)	537	335	53
HEATING EQUIPMENT	7,827	3,458	1,365
Heat-treating furnaces	3,915	2,010	682
Atmosphere generators	206	43	•
Stock-heating furnaces	739	308	293
Salt baths	711	421	95
Induction heating units	627	88	11
Baking and drying ovens	1,458	538	250
Flame-hardening units	171	50	33
CLEANING AND FINISHING	7,391	3,380	930
Cleaning Equipment	5,817	2,541	835
Barrel finishing machines	3,108	1,370	626
Shot and abrasive blast	817	323	158
Parts washing machines (incl degreasers)	1,812	796	40
Pickling machines	80	52	11
Plating Equipment	1,574	839	95
Machines	619	258	90
Barrels	955	581	•
INDUSTRIAL TRUCKS (Power-Driven)	2,954	888	154
Lift (rider-type)	1,624	493	96
Truck-tractor	288	46	28
Powered hand trucks	913	291	19
Crane trucks	129	58	11
OTHER SHOP EQUIPMENT	4,057	1,567	380
Balancing Machines	588	246	89
Air Compressors	3,107	1,204	237
Gear-Checking Machines	362	117	54



Bridgeport — Hartford

All of the state of Connecticut

981 plants — 258,841 employees

	Total Units	10 yr & over	Over 20 yr
METAL CUTTING	102,657	65%	22%
METAL FORMING	22,614	69	28
OTHER EQUIPMENT	17,792	50	11
TOTAL	143,063	64	21

• — Less than 10

	TOTAL	10-20 YEARS	OVER 20 YR
METAL-CUTTING MACHINES	102,657	44,472	22,385
Boring Machines	2,499	1,113	444
Horizontal boring, drilling, & milling	814	327	169
Vertical boring mills incl vert turret lathes	585	282	159
Precision, horizontal and vertical	273	106	24
Jig boring, horizontal and vertical	787	386	73
Other (except boring lathes)	40	12	19
Broaching Machines	396	161	140
Horizontal internal or combination	168	62	34
Horizontal surface	54	29	16
Vertical internal	185	10	44
Vertical surface or combination	137	53	28
Continuous horizontal & vertical	•	•	•
Other (incl rotary surface)	52	•	38
Contour Sawing and Filing	807	329	125
Cutoff Machines	3,140	1,219	404
Bandsaw (incl friction)	1,218	462	69
Abrasive disk	511	214	23
Hacksaws	892	395	187
Circular (incl friction)	369	105	92
Other	150	43	33
Drilling Machines	18,754	7,677	3,838
Sensitive	5,231	2,628	742
Upright: Single-spindle	7,240	2,366	944
Gang	2,453	1,253	403
Radial	1,014	431	227
Multi-spindle cluster, adjustable and fixed center	911	351	173
Automatic	196	61	33
Unit head & way type (not dial)	261	61	33
Deep-hole drills	406	79	280
Other (not incl special machines)	1,042	547	203
Gear Cutting and Finishing Machines	2,089	1,071	327
Hobbing machines, gear	775	421	112
Shapers, gear	435	264	18
Form-milling type (spur and bevel)	230	99	122
Bevel-gear cutters (not planer)	202	80	49
Grinders, gear tooth	196	99	19
Shavers, gear tooth	119	49	•
Burnishing and lapping	32	16	•
Chamfering, tooth pointing, tooth rounding	53	22	•
Other	47	21	•
Grinding Machines	23,734	11,443	4,587
External cylindrical: Plain	1,424	679	405
Universal	903	408	163
Internal cylindrical	1,154	420	262
Centerless: External	900	397	50
Internal	351	93	35
Surface: Rotary-table type	727	365	142
Reciprocating type	2,826	1,470	443
Disk, horizontal and vertical	969	601	94
Tool and cutter (incl drill)	3,513	1,828	718
Bench, floorstand, and snag	6,621	3,941	1,259
Jig grinders	112	53	•
Contour grinders	122	43	•
Abrasive belt (not polishing)	910	295	83
Other (except thread grinders)	3,204	852	922
Honing and Lapping	1,875	818	212
Honing: Internal (incl combination)	697	189	•
External and surface	101	31	•
Lapping: Surface	634	383	171
Cylindrical	93	44	11
Other (incl combination hone-lap)	350	171	24
Lathes	21,454	8,770	5,402
Bench, floor, lt-dy (incl turret attachment)	3,698	1,478	869
Engine, heavy-duty: Standard	3,182	1,297	1,036
Toolroom	2,476	1,052	513
Manufacturing and gap	330	139	47
Tracer	170	26	•
Turret lathes: Ram type	2,133	949	326
Saddle type	705	400	149
Auto chucking & between centers (single spindle)	293	145	73
Automatic chucking (multi-spindle)	766	347	165
Automatic screw machines (single spindle)	6,518	2,585	2,046
Automatic bar machines (multi-spindle)	1,101	304	62
Other (except spinning lathes)	282	48	112
Milling Machines	15,397	6,782	4,451
Bench type	684	311	106
Hand	2,136	895	800
Knee-type: Horizontal (plain & universal)	3,653	1,846	725
Vertical	2,203	970	237
Automatic & manufacturing	1,906	1,006	424
Ram type, swivel head	278	105	28
Bed (Lincoln) type, incl automatic rise and fall	1,723	849	673
Planer type (incl skin and spar)	110	46	26
Profilers, duplicators, diesinkers, engravers	718	304	147
Other (except thread milling)	1,906	370	1,285
Planers	505	101	363
Double housing	417	71	329
Openside and other	88	30	34
Pipe Cutting and Threading Machines	358	165	72
Polishing and Buffing Machines	5,403	2,632	841
Polishing stands (bench and floor)	2,131	1,101	405
Speed lathes	1,373	878	164
Abrasive-belt, disk, drum	1,261	485	98
Other	638	168	174
Shapers	1,528	575	723
Horizontal	1,272	489	576
Vertical, incl slotters & keyseaters	256	86	147
Threading (except pipe)	3,440	1,449	979
Tapping	1,120	417	249
Hobbing and milling	505	180	240
Die type	172	30	30
Grinders, thread	486	300	56
Rolling machines, thread	341	61	180
Other	816	461	224

	TOTAL	10-20 YEARS	OVER 20 YR
Electro-Erosion Machines (exc Tap disintegrators)	38	•	•
Ultrasonic Cutting Machines	•	•	•
Special Multi-Station Machines	422	70	41
In-line and transfer	59	19	•
Dial or rotary table	280	43	16
Automatic assembly (all types)	83	•	25
Other Metal-Cutting Machines	415	94	216
METAL-FORMING MACHINES	22,614	9,131	6,410
Bending and Forming Machines (Power)	1,938	952	259
Bending rolls, sheet and plate	792	490	101
Bending rolls, bars and shapes	79	48	•
Bending brakes	712	316	98
Rotary bending and forming machines	119	48	24
Bending machines, pipe, bar, and shapes	236	50	72
Wire and Strip Forming Machines	643	89	286
Hydraulic Presses	1,015	328	84
Vertical, single-action	763	246	47
Vertical, double and triple action	122	66	15
Horizontal	54	•	16
Extrusion (from hot billets)	•	•	•
Other (incl stretch and hydro-pneumatic)	72	11	•
Pneumatic Presses (except hydro-pneumatic)	521	170	•
Mechanical Presses (Power)	12,509	5,072	4,560
Inclinable, single-action (incl inclined)	6,563	2,927	1,999
Vertical, single-action: Straight-side (incl arch)	1,975	410	1,313
Vertical, single-action: Gap or C-frame	2,289	1,077	860
Vertical, single-action: Adjust. bed and herning	143	56	68
Double and triple action	405	224	49
Dieing machines	291	115	119
Horizontal (incl bulldozers)	28	13	16
Multiple transfer (incl eyeletting)	329	59	41
Other	488	191	95
Punching and Shearing Machines	1,450	535	347
Punching machines (incl turret)	346	151	61
Plate and sheet shears	662	208	198
Bar and angle shears	87	15	21
Rotary shears, incl slitters	94	35	26
Nibbling machines	215	115	23
Other	46	11	18
Forging Machinery (except presses)	738	303	299
Hammers, steam or air	49	14	34
Hammers, mechanical (incl drop and helve)	224	59	165
Forging machines (headers) and rolls	406	220	80
Swaging machines	53	•	16
Other	•	•	•
Riveting Machines (not portable)	2,871	1,244	533
Squeeze type	960	329	89
Rotary-vibrating type	672	288	178
Spinning type	803	423	204
Hammer type	436	204	62
Die Casting Machines	28	12	•
Hot chamber	28	12	•
Cold chamber	•	•	•
Plastics Molding Machines	901	426	39
Injection	101	35	•
Compression	788	386	39
Extrusion	12	•	•
WELDING EQUIPMENT	3,769	1,814	320
Electric Welding Equipment	3,561	1,733	306
Power source: Motor-generator set	1,073	639	71
Transformer and rectifier	648	311	15
Arc-weld machines (not hand) incl automatic	336	139	•
Resistance welders: Spot	1,259	562	183
Gun (not hand)	30	•	•
Seam	39	14	•
Butt and flash	176	63	28
Gas Welding Machines (not hand)	69	•	•
Flame Cutting Machines (not hand)	139	79	14
HEATING EQUIPMENT	4,208	1,676	632
Heat-treating furnaces	1,890	844	355
Atmosphere generators	282	80	22
Stock-heating furnaces	323	99	94
Salt baths	492	282	49
Induction heating units	413	109	38
Baking and drying ovens	583	132	38
Flame-hardening units	225	130	36
CLEANING AND FINISHING	6,001	1,992	805
Cleaning Equipment	4,774	1,502	624
Barrel finishing machines	3,209	925	327
Shot and abrasive blast	386	157	39
Parts washing machines (incl degreasers)	1,129	404	47
Pickling machines	50	12	11
Plating Equipment	1,227	490	181
Machines	321	89	36
Barrels	906	401	145
INDUSTRIAL TRUCKS (Power-Driven)	1,679	575	75
Lift (rider-type)	1,017	312	56
Truck-tractor	189	59	14
Powered hand trucks	426	192	•
Crane trucks	47	12	•
OTHER SHOP EQUIPMENT	2,133	791	143
Balancing Machines	193	62	12
Air Compressors	1,571	659	109
Gear-Checking Machines	369	70	22

2676 plants — 356,669 employees

	Total Units	10 yr & over	Over 20 yr
METAL CUTTING	154,675	59%	13%
METAL FORMING	47,813	62	20
OTHER EQUIPMENT	50,632	48	6
TOTAL	253,120	58	13

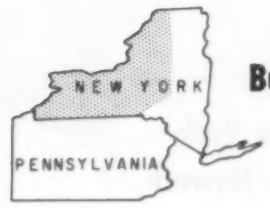
◆ – Less than 10

New York State east of a line that includes counties of Franklin, Hamilton, Fulton, Montgomery, Schoharie, Delaware, Sullivan, Orange, Rockland, Westchester, Bronx, New York, and Richmond; New Jersey north of a line that includes counties of Hunterdon, Somerset, and Middlesex

New York — Newark

	TOTAL	10-20 YEARS	OVER 20 YR
METAL-CUTTING MACHINES	154,675	71,239	20,387
Boring Machines	5,143	2,546	755
Horizontal boring, drilling, & milling	1,828	1,003	292
Vertical boring mills incl vert turret lathes	1,550	753	391
Precision, horizontal and vertical	626	362	◆
Jig boring, horizontal and vertical	1,021	357	54
Other (except boring lathes)	118	71	15
Broaching Machines	788	391	88
Horizontal internal or combination	401	188	67
Horizontal surface	45	15	◆
Vertical internal	108	71	18
Vertical surface or combination	185	85	◆
Continuous horizontal & vertical	◆	◆	◆
Other (incl rotary surface)	42	28	◆
Contour Sawing and Filing	1,655	870	57
Cutoff Machines	9,098	4,060	751
Bandsaw (incl friction)	3,172	1,316	171
Abrasive disk	1,693	889	72
Hacksaws	2,467	1,142	311
Circular (incl friction)	1,357	545	126
Other	409	168	71
Drilling Machines	32,850	15,275	3,776
Sensitive	5,304	2,538	538
Upright: Single-spindle	16,766	7,719	1,793
Gang	3,989	1,966	425
Radial	2,968	1,311	612
Multi-spindle cluster, adjustable and fixed center	1,278	642	202
Automatic	533	166	◆
Unit head & way type (not dial)	572	300	16
Deep-hole drills	209	77	15
Other (not incl special machines)	1,231	556	173
Gear Cutting and Finishing Machines	3,031	1,597	537
Hobbing machines, gear	887	396	137
Shapers, gear	958	627	118
Form-milling type (spur and bevel)	138	89	40
Bevel-gear cutters (not planer)	538	215	180
Grinders, gear tooth	118	91	◆
Shavers, gear tooth	117	66	◆
Burnishing and lapping	197	104	◆
Chamfering, tooth pointing, tooth rounding	15	◆	◆
Other	63	◆	46
Grinding Machines	30,430	14,895	3,710
External cylindrical: Plain	2,177	1,362	237
Universal	1,051	521	147
Internal cylindrical	1,249	769	110
Centerless: External	997	514	132
Internal	752	360	207
Surface: Rotary-table type	1,450	748	147
Reciprocating type	4,642	1,905	422
Disk, horizontal and vertical	1,097	379	177
Tool and cutter (incl drill)	4,527	2,338	560
Bench, floorstand, and snag	8,036	4,176	860
Jig grinders	98	29	◆
Contour grinders	509	398	◆
Abrasive belt (not polishing)	2,334	937	89
Other (except thread grinders)	1,511	459	617
Honing and Lapping	1,553	730	155
Honing: Internal (incl combination)	737	347	12
External and surface	84	41	◆
Lapping: Surface	408	196	◆
Cylindrical	116	65	21
Other (incl combination hone-lap)	208	81	107
Lathes	32,785	15,449	5,081
Bench, floor, ll-dy (incl turret attachment)	7,559	3,581	1,043
Engine, heavy-duty: Standard	7,119	3,237	1,892
Toolroom	4,106	1,950	413
Manufacturing and gap	356	115	97
Tracer	393	53	◆
Turret lathes: Ram type	4,333	2,543	404
Saddle type	1,855	1,168	245
Auto chucking & between centers (single spindle)	798	384	90
Automatic chucking (multi-spindle)	485	257	51
Automatic screw machines (single spindle)	3,742	1,303	459
Automatic bar machines (multi-spindle)	893	490	45
Other (except spinning lathes)	1,066	368	342
Milling Machines	18,773	7,934	2,731
Bench type	994	366	117
Hand	1,442	636	245
Knee-type: Horizontal (plain & universal)	6,865	3,102	1,438
Vertical	4,360	1,864	214
Automatic & manufacturing	731	397	45
Ram type, swivel head	767	222	10
Bed (Lincoln) type, incl automatic rise and fall	942	315	86
Planer type (incl skin and spar)	238	78	94
Profilers, duplicators, diesinkers, engravers	1,625	624	158
Other (except thread milling)	809	330	324
Planers	818	263	411
Double housing	558	168	344
Openside and other	260	95	67
Pipe Cutting and Threading Machines	1,228	524	124
Polishing and Buffing Machines	7,751	3,065	752
Polishing stands (bench and floor)	3,975	1,448	293
Speed lathes	1,480	870	291
Abrasive-belt, disk, drum	1,840	670	120
Other	456	77	48
Shapers	3,232	1,478	1,012
Horizontal	2,520	1,180	847
Vertical, incl slotters & keyseaters	712	298	165
Threading (except pipe)	4,291	1,766	345
Tapping	1,893	640	140
Hobbing and milling	634	347	74
Die type	290	97	69
Grinders, thread	437	293	◆
Rolling machines, thread	773	277	57
Other	264	112	◆

	TOTAL	10-20 YEARS	OVER 20 YR
Electro-Erosion Machines (exc Tap disintegrators)	39	◆	◆
Ultrasonic Cutting Machines	18	◆	◆
Special Multi-Station Machines	905	185	47
In-line and transfer	397	105	◆
Dial or rotary table	227	41	◆
Automatic assembly (all types)	281	39	38
Other Metal-Cutting Machines	367	200	55
METAL-FORMING MACHINES	47,813	20,333	9,490
Bending and Forming Machines (Power)	5,237	1,983	811
Bending rolls, sheet and plate	1,210	418	354
Bending rolls, bars and shapes	496	228	82
Bending brakes	2,618	1,022	285
Rotary bending and forming machines	267	87	59
Bending machines, pipe, bar, and shapes	646	228	31
Wire and Strip Forming Machines	1,084	505	126
Hydraulic Presses	3,018	1,527	308
Vertical, single-action	1,645	525	193
Vertical, double and triple action	355	150	71
Horizontal	568	497	21
Extrusion (from hot billets)	28	18	◆
Other (incl stretch and hydro-pneumatic)	422	337	16
Pneumatic Presses (except hydro-pneumatic)	621	157	71
Mechanical Presses (Power)	25,478	11,004	5,928
Inclinable, single-action (incl inclined)	16,284	7,911	3,472
Vertical, single-action: Straight-side (incl arch)	2,256	1,015	600
Vertical, single-action: Gap or C-frame	3,179	840	737
Vertical, single-action: Adjust. bed and horning	292	98	118
Double and triple action	808	277	169
Dieing machines	200	67	17
Horizontal (incl bulldozers)	80	◆	30
Multiple transfer (incl eyeletting)	489	295	56
Other	1,890	500	729
Punching and Shearing Machines	6,064	2,446	1,431
Punching machines (incl turret)	1,409	513	385
Plate and sheet shears	2,377	1,085	354
Bar and angle shears	502	166	187
Rotary shears, incl slitters	829	275	407
Nibbling machines	647	251	44
Other	300	156	54
Forging Machinery (except presses)	1,270	607	410
Hammers, steam or air	216	82	58
Hammers, mechanical (incl drop and helve)	354	116	190
Forging machines (headers) and rolls	315	206	30
Swaging machines	354	202	103
Other	31	◆	29
Riveting Machines (not portable)	4,283	1,770	353
Squeeze type	1,942	566	114
Rotary-vibrating type	321	129	69
Spinning type	673	546	41
Hammer type	1,347	529	129
Die Casting Machines	181	76	◆
Hot chamber	178	75	◆
Cold chamber	◆	◆	◆
Plastics Molding Machines	577	258	51
Injection	262	113	12
Compression	279	145	39
Extrusion	36	◆	◆
WELDING EQUIPMENT	21,524	9,187	1,346
Electric Welding Equipment	20,448	8,723	1,282
Power source: Motor-generator set	5,820	3,564	508
Transformer and rectifier	5,840	1,812	182
Arc-weld machines (not hand) incl automatic	2,398	1,200	51
Resistance welders: Spot	5,829	1,965	451
Gun (not hand)	135	36	◆
Seam	132	92	◆
Butt and flash	294	54	89
Gas Welding Machines (not hand)	369	156	◆
Flame Cutting Machines (not hand)	707	308	57
HEATING EQUIPMENT	8,824	3,768	819
Heat-treating furnaces	3,876	2,020	413
Atmosphere generators	261	127	◆
Stock-heating furnaces	470	199	84
Salt baths	661	260	90
Induction heating units	729	195	◆
Baking and drying ovens	2,552	846	202
Flame-hardening units	275	121	28
CLEANING AND FINISHING	9,292	4,253	585
Cleaning Equipment	6,958	3,033	485
Barrel finishing machines	3,649	1,623	314
Shot and abrasive blast	1,010	584	47
Parts washing machines (incl degreasers)	2,128	741	124
Pickling machines	171	85	◆
Plating Equipment	2,334	1,220	100
Machines	1,024	485	76
Barrels	1,310	735	24
INDUSTRIAL TRUCKS (Power-Driven)	4,510	1,438	62
Lift (rider-type)	2,555	775	16
Truck-tractor	648	116	17
Powered hand trucks	1,086	451	10
Crane trucks	221	96	19
OTHER SHOP EQUIPMENT	6,482	2,526	349
Balancing Machines	740	295	38
Air Compressors	5,319	2,035	294
Gear-Checking Machines	423	196	17



Buffalo — Syracuse

New York State west of a line that includes counties of St. Lawrence, Herkimer, Otsego, Chenango, and Broome

790 plants — 395,143 employees

	Total Units	10 yr & over	Over 20 yr
METAL CUTTING	74,266	64%	19%
METAL FORMING	26,034	60	26
OTHER EQUIPMENT	26,435	49	8
TOTAL	126,735	60	18

• – Less than 10

	TOTAL	10-20 YEARS	OVER 20 YR
METAL-CUTTING MACHINES	74,266	33,511	14,266
Boring Machines	2,727	1,308	682
Horizontal boring, drilling, & milling	945	513	189
Vertical boring mills incl vert turret lathes	1,052	510	400
Precision, horizontal and vertical	305	129	15
Jig boring, horizontal and vertical	298	126	23
Other (except boring lathes)	127	30	55
Broaching Machines	541	241	82
Horizontal internal or combination	208	92	48
Horizontal surface	87	52	•
Vertical internal	61	15	18
Vertical surface or combination	171	78	•
Continuous horizontal & vertical	•	•	•
Other (incl rotary surface)	13	•	•
Contour Sawing and Filing	681	349	55
Cutoff Machines	4,160	1,696	484
Bandsaw (incl friction)	1,426	623	96
Abrasive disk	666	274	53
Hacksaws	1,322	561	240
Circular (incl friction)	503	170	69
Other	243	68	26
Drilling Machines	14,916	6,908	2,769
Sensitive	3,076	1,389	697
Upright: Single-spindle	5,839	2,668	1,047
Gang	1,789	941	325
Radial	1,676	735	439
Multi-spindle cluster, adjustable and fixed center	1,035	601	141
Automatic	295	59	16
Unit head & way type (not dial)	133	47	13
Deep-hole drills	30	11	•
Other (not incl special machines)	1,043	457	91
Gear Cutting and Finishing Machines	2,065	828	308
Hobbing machines, gear	610	255	115
Shapers, gear	589	270	123
Form-milling type (spur and bevel)	61	19	23
Bevel-gear cutters (not planer)	359	123	21
Grinders, gear tooth	71	29	•
Shavers, gear tooth	145	55	•
Burnishing and lapping	56	20	•
Chamfering, tooth pointing, tooth rounding	94	26	•
Other	80	31	22
Grinding Machines	13,995	6,693	2,162
External cylindrical: Plain	1,194	547	276
Universal	396	206	56
Internal cylindrical	481	229	113
Centerless: External	449	146	103
Internal	146	64	35
Surface: Rotary-table type	938	414	143
Reciprocating type	1,497	784	191
Disk, horizontal and vertical	706	290	207
Tool and cutter (incl drill)	2,558	1,240	330
Bench, floorstand, and snag	3,776	2,024	570
Jig grinders	29	14	•
Contour grinders	104	58	•
Abrasive belt (not polishing)	1,040	437	42
Other (except thread grinders)	681	240	90
Honing and Lapping	604	282	49
Honing: Internal (incl combination)	352	154	32
External and surface	31	27	•
Lapping: Surface	90	40	16
Cylindrical	90	44	•
Other (incl combination hone-lap)	41	17	•
Lathes	17,530	8,081	3,955
Bench, floor, ft-dy (incl turret attachment)	2,579	1,099	512
Engine, heavy-duty: Standard	3,451	1,497	1,166
Toolroom	1,531	605	390
Manufacturing and gap	370	122	120
Tracer	84	31	•
Turret lathes: Ram type	2,842	1,477	483
Saddle type	1,261	742	227
Auto chucking & between centers (single spindle)	993	497	198
Automatic chucking (multi-spindle)	515	158	28
Automatic screw machines (single spindle)	2,629	1,250	589
Automatic bar machines (multi-spindle)	1,088	494	120
Other (except spinning lathes)	387	109	122
Milling Machines	8,017	3,548	1,825
Bench type	325	146	51
Hand	1,167	462	475
Knee-type: Horizontal (plain & universal)	2,981	1,366	750
Vertical	1,604	725	177
Automatic & manufacturing	632	295	179
Ram type, swivel head	115	32	•
Bed (Lincoln) type, incl automatic rise and fall	220	130	37
Planer type (incl skin and spar)	200	138	17
Profilers, duplicators, diesinkers, engravers	463	185	98
Other (except thread milling)	310	69	38
Planers	475	166	229
Double housing	349	134	181
Openside and other	126	32	58
Pipe Cutting and Threading Machines	519	235	69
Polishing and Buffing Machines	3,838	1,467	533
Polishing stands (bench and floor)	2,062	759	358
Speed lathes	319	133	79
Abrasive-belt, disk, drum	1,078	372	77
Other	379	203	19
Shapers	1,591	637	596
Horizontal	1,237	515	468
Vertical, incl slotters & keyseaters	354	122	128
Threading (except pipe)	1,969	955	481
Tapping	1,139	594	184
Hobbing and milling	158	96	41
Die type	81	45	•
Grinders, thread	82	38	•
Rolling machines, thread	132	20	33
Other	377	162	131

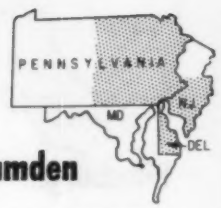
	TOTAL	10-20 YEARS	OVER 20 YR
Electro-Erosion Machines (exc Tap disintegrators)	47	18	•
Ultrasonic Cutting Machines	•	•	•
Special Multi-Station Machines	399	38	46
In-line and transfer	242	15	•
Dial or rotary table	114	22	38
Automatic assembly (all types)	43	•	•
Other Metal-Cutting Machines	190	61	11
METAL-FORMING MACHINES	26,034	8,881	6,778
Bending and Forming Machines (Power)	2,779	994	416
Bending rolls, sheet and plate	728	244	166
Bending rolls, bars and shapes	160	85	39
Bending brakes	1,389	521	166
Rotary bending and forming machines	166	51	18
Bending machines, pipe, bar, and shapes	336	93	27
Wire and Strip Forming Machines	844	200	83
Hydraulic Presses	1,699	616	283
Vertical, single-action	1,299	416	220
Vertical, double and triple action	174	97	•
Horizontal	95	51	21
Extrusion (from hot billets)	48	48	•
Other (incl stretch and hydro-pneumatic)	83	•	42
Pneumatic Presses (except hydro-pneumatic)	416	110	•
Mechanical Presses (Power)	12,783	3,973	4,455
Inclinable, single-action (incl inclined)	5,762	2,064	1,674
Vertical, single-action: Straight-side (incl arch)	2,979	734	1,354
Vertical, single-action: Gap or C-frame	1,661	485	619
Horizontal	661	228	247
Double and triple action	841	188	307
Dieing machines	56	19	•
Horizontal (incl bulldozers)	66	17	28
Multiple transfer (incl eyeletting)	165	76	32
Other	512	162	190
Punching and Shearing Machines	2,950	1,135	686
Punching machines (incl turret)	851	268	247
Plate and sheet shears	1,362	554	303
Bar and angle shears	243	111	52
Rotary shears, incl slitters	213	42	50
Nibbling machines	220	152	17
Other	61	•	17
Forging Machinery (except presses)	970	364	389
Hammers, steam or air	65	29	15
Hammers, mechanical (incl drop and helve)	322	99	198
Forging machines (headers) and rolls	155	11	107
Swaging machines	288	186	69
Other	140	39	•
Riveting Machines (not portable)	2,761	1,047	415
Squeeze type	1,325	558	32
Rotary-vibrating type	454	126	212
Spinning type	295	102	94
Hammer type	687	261	77
Die Casting Machines	202	33	•
Hot chamber	190	27	•
Cold chamber	12	•	•
Plastics Molding Machines	710	409	34
Injection	46	•	•
Compression	664	400	34
Extrusion	•	•	•
WELDING EQUIPMENT	11,481	5,432	765
Electric Welding Equipment	10,992	5,208	737
Power source: Motor-generator set	4,094	2,663	228
Transformer and rectifier	2,162	823	42
Arc-weld machines (not hand) incl automatic	1,131	326	60
Resistance welders: Spot	2,798	1,107	368
Gun (not hand)	209	52	•
Seam	148	61	•
Butt and flash	450	176	33
Gas Welding Machines (not hand)	70	30	16
Flame Cutting Machines (not hand)	419	194	12
HEATING EQUIPMENT	4,829	1,929	623
Heat-treating furnaces	2,205	996	315
Atmosphere generators	73	12	•
Stock-heating furnaces	368	139	126
Salt baths	393	156	65
Induction heating units	333	130	•
Baking and drying ovens	1,362	475	83
Flame-hardening units	95	21	31
CLEANING AND FINISHING	3,620	1,240	321
Cleaning Equipment	3,074	1,087	318
Barrel finishing machines	1,280	540	170
Shot and abrasive blast	554	223	52
Parts washing machines (incl degreasers)	1,159	302	87
Pickling machines	81	22	•
Plating Equipment	546	153	•
Machines	274	46	•
Barrels	272	107	•
INDUSTRIAL TRUCKS (Power-Driven)	3,921	1,321	106
Lift (rider-type)	2,340	835	77
Truck-tractor	536	196	•
Powered hand trucks	930	247	11
Crane trucks	115	43	16
OTHER SHOP EQUIPMENT	2,584	953	322
Balancing Machines	492	206	60
Air Compressors	1,789	644	255
Gear-Checking Machines	303	103	•

1256 plants — 414,662 employees

	Total Units	10 yr & over	Over 20 yr
METAL CUTTING	77,041	61%	18%
METAL FORMING	28,794	64	25
OTHER EQUIPMENT	40,059	52	6
TOTAL	145,894	59	16

• – Less than 10

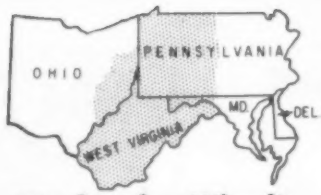
Pennsylvania east of a line that includes counties of Tioga, Lycoming, Union, Mifflin, Juniata, and Franklin; New Jersey south of a line that includes counties of Mercer and Monmouth; all of the state of Delaware



Philadelphia — Camden

	TOTAL	10-20 YEARS	OVER 20 YR
METAL-CUTTING MACHINES	77,041	33,392	13,682
Boring Machines	2,703	1,097	664
Horizontal boring, drilling, & milling	1,019	421	274
Vertical boring mills incl vert turret lathes	1,000	474	330
Precision, horizontal and vertical	292	87	•
Jig boring, horizontal and vertical	304	91	18
Other (except boring lathes)	88	24	42
Broaching Machines	533	199	119
Horizontal internal or combination	163	83	39
Horizontal surface	23	11	•
Vertical internal	169	61	70
Vertical surface or combination	141	42	•
Continuous horizontal & vertical	31	•	•
Other (incl rotary surface)	•	•	•
Contour Sawing and Filing	777	414	26
Cutoff Machines	5,406	2,360	561
Bandsaw (incl friction)	1,990	901	160
Abrasive disk	1,007	383	67
Hacksaws	1,679	834	234
Circular (incl friction)	495	163	72
Other	235	79	28
Drilling Machines	16,245	7,321	2,202
Sensitive	2,538	1,055	199
Upright: Single-spindle	7,463	3,708	1,058
Gang	2,236	810	245
Radial	2,324	1,158	523
Multi-spindle cluster, adjustable and fixed center	777	266	98
Automatic	189	•	18
Unit head & way type (not dial)	64	•	•
Deep-hole drills	130	53	29
Other (not incl special machines)	524	260	32
Gear Cutting and Finishing Machines	1,206	598	259
Hobbing machines, gear	563	267	128
Shapers, gear	295	160	52
Form-milling type (spur and bevel)	106	24	62
Bevel-gear cutters (not planer)	101	51	•
Grinders, gear tooth	19	•	•
Shavers, gear tooth	38	21	•
Burnishing and lapping	•	•	•
Chamfering, tooth pointing, tooth rounding	64	61	•
Other	14	•	•
Grinding Machines	15,767	7,066	2,552
External cylindrical: Plain	908	407	207
Universal	525	241	56
Internal cylindrical	419	200	45
Centerless: External	249	106	22
Internal	54	•	10
Surface: Rotary-table type	754	323	154
Reciprocating type	2,151	942	262
Disk, horizontal and vertical	697	225	191
Tool and cutter (incl drill)	2,816	1,283	491
Bench, floorstand, and snag	4,933	2,585	710
Jig grinders	95	13	19
Contour grinders	98	37	•
Abrasive belt (not polishing)	975	353	58
Other (except thread grinders)	1,093	344	325
Honing and Lapping	664	213	21
Honing: Internal (incl combination)	361	131	14
External and surface	23	11	•
Lapping: Surface	214	42	•
Cylindrical	42	17	•
Other (incl combination hone-lap)	24	12	•
Lathes	15,690	6,946	3,365
Bench, floor, ft-dy (incl turret attachment)	2,473	1,247	376
Engine, heavy-duty: Standard	4,343	1,841	1,443
Toolroom	1,718	853	293
Manufacturing and gap	191	84	37
Tracer	146	•	•
Turret lathes: Ram type	2,248	999	372
Saddle type	1,194	536	252
Auto chucking & between centers (single spindle)	481	131	46
Automatic chucking (multi-spindle)	171	54	66
Automatic screw machines (single spindle)	1,409	664	182
Automatic bar machines (multi-spindle)	1,043	450	223
Other (except spinning lathes)	273	79	75
Milling Machines	7,652	3,342	1,703
Bench type	337	152	80
Hand	824	340	254
Knee-type: Horizontal (plain & universal)	3,213	1,443	850
Vertical	1,584	650	258
Automatic & manufacturing	345	187	63
Ram type, swivel head	344	133	47
Bed (Lincoln) type, incl automatic rise and fall	174	96	15
Planer type (incl skin and spar)	118	59	35
Profilers, duplicators, diesinkers, engravers	369	171	55
Other (except thread milling)	344	111	46
Planers	766	218	456
Double housing	470	111	299
Openside and other	296	107	157
Pipe Cutting and Threading Machines	1,102	417	282
Polishing and Buffing Machines	4,236	1,219	354
Polishing stands (bench and floor)	2,401	673	170
Speed lathes	416	165	45
Abrasive-belt, disk, drum	1,023	234	127
Other	396	147	12
Shapers	1,984	899	752
Horizontal	1,632	708	658
Vertical, incl slotters & keyseaters	352	191	94
Threading (except pipe)	1,681	873	299
Tapping	831	418	125
Hobbing and milling	284	141	25
Die type	318	175	56
Grinders, thread	205	113	22
Rolling machines, thread	50	10	19
Other	73	16	52

	TOTAL	10-20 YEARS	OVER 20 YR
Electro-Erosion Machines (exc Tap disintegrators)	34	•	•
Ultrasonic Cutting Machines	•	•	•
Special Multi-Station Machines	380	155	17
In-line and transfer	25	12	•
Dial or rotary table	216	89	15
Automatic assembly (all types)	139	54	•
Other Metal-Cutting Machines	209	55	90
METAL-FORMING MACHINES	28,794	11,083	7,286
Bending and Forming Machines (Power)	4,294	1,603	634
Bending rolls, sheet and plate	1,080	442	218
Bending rolls, bars and shapes	369	118	46
Bending brakes	1,924	731	276
Rotary bending and forming machines	288	47	10
Bending machines, pipe, bar, and shapes	633	265	84
Wire and Strip Forming Machines	407	179	11
Hydraulic Presses	1,470	428	256
Vertical, single-action	1,072	374	164
Vertical, double and triple action	79	11	36
Horizontal	228	13	52
Extrusion (from hot billets)	•	•	•
Other (incl stretch and hydro-pneumatic)	84	26	•
Pneumatic Presses (except hydro-pneumatic)	164	12	•
Mechanical Presses (Power)	12,535	4,760	4,095
Inclinable, single-action (incl inclined)	6,276	2,403	1,531
Vertical, single-action: Straight-side (incl arch)	2,798	805	1,586
Vertical, single-action: Gap or C-frame	1,956	976	456
Vertical, single-action: Adjust. bed and horning	410	182	209
Double and triple action	343	121	124
Dieing machines	104	21	24
Horizontal (incl bulldozers)	130	26	86
Multiple transfer (incl eyeletting)	230	107	11
Other	268	119	68
Punching and Shearing Machines	4,353	1,881	1,106
Punching machines (incl turret)	1,201	530	376
Plate and sheet shears	1,615	690	363
Bar and angle shears	477	276	128
Rotary shears, incl slitters	401	165	146
Nibbling machines	426	122	66
Other	233	98	27
Forging Machinery (except presses)	2,005	822	844
Hammers, steam or air	333	80	231
Hammers, mechanical (incl drop and helve)	340	69	216
Forging machines (headers) and rolls	941	550	195
Swaging machines	354	123	201
Other	•	•	•
Riveting Machines (not portable)	2,640	937	309
Squeeze type	1,053	322	104
Rotary-vibrating type	624	272	29
Spinning type	209	98	37
Hammer type	754	245	139
Die Casting Machines	89	30	•
Hot chamber	89	30	•
Cold chamber	•	•	•
Plastics Molding Machines	837	431	28
Injection	107	27	28
Compression	702	380	•
Extrusion	28	24	•
WELDING EQUIPMENT	22,545	11,644	518
Electric Welding Equipment	21,454	11,197	493
Power source: Motor-generator set	5,595	3,477	219
Transformer and rectifier	6,607	2,417	32
Arc-weld machines (not hand) incl automatic	2,175	1,119	32
Resistance welders: Spot	6,171	3,975	166
Gun (not hand)	526	106	•
Seam	69	17	19
Butt and flash	311	86	24
Gas Welding Machines (not hand)	185	47	•
Flame Cutting Machines (not hand)	906	400	23
HEATING EQUIPMENT	5,417	2,236	627
Heat-treating furnaces	2,498	1,148	357
Atmosphere generators	178	47	•
Stock-heating furnaces	754	470	159
Salt baths	390	159	54
Induction heating units	510	40	•
Baking and drying ovens	972	348	39
Flame-hardening units	115	24	10
CLEANING AND FINISHING	4,630	1,719	1,044
Cleaning Equipment	3,635	1,264	888
Barrel finishing machines	1,973	552	809
Shot and abrasive blast	529	240	30
Parts washing machines (incl degreasers)	1,040	410	47
Pickling machines	93	62	•
Plating Equipment	1,015	455	156
Machines	435	169	109
Barrels	580	286	47
INDUSTRIAL TRUCKS (Power-Driven)	4,527	1,391	164
Lift (rider-type)	2,424	783	95
Truck-tractor	588	158	23
Powered hand trucks	1,228	375	•
Crane trucks	287	75	42
OTHER SHOP EQUIPMENT	2,920	1,265	233
Balancing Machines	221	71	28
Air Compressors	2,595	1,145	194
Gear-Checking Machines	104	49	19



Pittsburgh—Wheeling

Pennsylvania west of a line that includes counties of Potter, Clinton, Centre, Huntingdon, and Fulton; in Ohio, counties of Columbiana, Carroll, Harrison, Jefferson, Belmont, Monroe, and Washington; in Maryland, counties of Garrett and Allegany; all of the state of West Virginia

741 plants — 227,614 employees

	Total Units	10 yr & over	Over 20 yr
METAL CUTTING	45,975	67%	19%
METAL FORMING	19,272	71	31
OTHER EQUIPMENT	26,313	53	6
TOTAL	91,560	64	18

◆ — Less than 10

	TOTAL	10-20 YEARS	OVER 20 YR
METAL-CUTTING MACHINES	45,975	21,593	8,898
Boring Machines	2,075	963	580
Horizontal boring, drilling, & milling	992	470	266
Vertical boring mills incl vert turret lathes	812	400	281
Precision, horizontal and vertical	29	10	◆
Jig boring, horizontal and vertical	167	72	10
Other (except boring lathes)	75	11	18
Broaching Machines	190	103	40
Horizontal internal or combination	121	67	35
Horizontal surface	◆	◆	◆
Vertical internal	28	19	◆
Vertical surface or combination	36	14	◆
Continuous horizontal & vertical	◆	◆	◆
Other (incl rotary surface)	◆	◆	◆
Contour Sawing and Filing	594	293	◆
Cutoff Machines	3,816	1,598	469
Bandsaw (incl friction)	1,240	536	103
Abrasive disk	382	150	41
Hacksaws	1,230	676	169
Circular (incl friction)	638	176	134
Other	326	60	22
Drilling Machines	7,551	3,292	1,833
Sensitive	1,277	480	313
Upright: Single-spindle	3,123	1,458	602
Gang	339	170	51
Radial	1,816	848	492
Multi-spindle cluster, adjustable and fixed center	347	183	56
Automatic	44	19	◆
Unit head & way type (not dial)	52	22	◆
Deep-hole drills	37	19	12
Other (not incl special machines)	516	93	307
Gear Cutting and Finishing Machines	550	312	126
Hobbing machines, gear	245	115	77
Shapers, gear	176	135	16
Form-milling type (spur and bevel)	38	13	13
Bevel-gear cutters (not planer)	33	14	◆
Grinders, gear tooth	27	16	◆
Shavers, gear tooth	◆	◆	◆
Burnishing and lapping	◆	◆	◆
Chamfering, tooth pointing, tooth rounding	◆	◆	◆
Other	22	13	◆
Grinding Machines	9,869	4,635	1,396
External cylindrical: Plain	579	363	111
Universal	257	157	30
Internal cylindrical	214	116	54
Centerless: External	99	51	◆
Internal	22	17	◆
Surface: Rotary-table type	464	191	54
Reciprocating type	1,550	766	115
Disk, horizontal and vertical	548	261	141
Tool and cutter (incl drill)	1,933	923	256
Bench, floorstand, and snag	2,958	1,277	560
Jig grinders	90	60	10
Contour grinders	137	72	◆
Abrasive belt (not polishing)	562	194	21
Other (except thread grinders)	456	187	34
Honing and Lapping	315	88	◆
Honing: Internal (incl combination)	81	52	◆
External and surface	37	◆	◆
Lapping: Surface	118	◆	◆
Cylindrical	17	◆	◆
Other (incl combination hone-lap)	62	15	◆
Lathes	9,206	4,669	2,084
Bench, floor, ll-dy (incl turret attachment)	913	462	145
Engine, heavy-duty: Standard	3,186	1,353	1,112
Toolroom	1,408	890	142
Manufacturing and gap	83	29	22
Tracer	95	21	◆
Turret lathes: Ram type	1,263	721	213
Saddle type	1,108	695	161
Auto chucking & between centers (single spindle)	206	95	◆
Automatic chucking (multi-spindle)	42	33	◆
Automatic screw machines (single spindle)	259	104	81
Automatic bar machines (multi-spindle)	267	153	29
Other (except spinning lathes)	376	113	166
Milling Machines	4,534	2,234	762
Bench type	189	114	28
Hand	268	143	67
Knee-type: Horizontal (plain & universal)	1,783	935	345
Vertical	1,296	587	111
Automatic & manufacturing	101	85	◆
Ram type, swivel head	176	54	◆
Bed (L.incoln) type, incl automatic rise and fall	225	105	73
Planer type (incl skin and spar)	173	59	64
Profilers, duplicators, diesinkers, engravers	236	121	40
Other (except thread milling)	87	31	23
Planers	793	368	362
Double housing	550	266	260
Openside and other	243	102	102
Pipe Cutting and Threading Machines	963	369	251
Polishing and Buffing Machines	1,985	1,015	118
Polishing stands (bench and floor)	944	385	65
Speed lathes	183	105	23
Abrasive-belt, disk, drum	752	443	15
Other	106	82	15
Shapers	1,879	916	571
Horizontal	1,475	740	424
Vertical, incl slotters & keyseaters	404	176	147
Threading (except pipe)	833	331	191
Tapping	301	97	48
Hobbing and milling	39	23	◆
Die type	221	100	70
Grinders, thread	48	46	◆
Rolling machines, thread	202	65	62
Other	22	◆	◆

	TOTAL	10-20 YEARS	OVER 20 YR
Electro-Erosion Machines (exc Tap disintegrators)	21	◆	◆
Ultrasonic Cutting Machines	◆	◆	◆
Special Multi-Station Machines	93	29	12
In-line and transfer	82	◆	◆
Dial or rotary table	82	25	12
Automatic assembly (all types)	◆	◆	◆
Other Metal-Cutting Machines	708	378	91
METAL-FORMING MACHINES	19,272	7,591	6,041
Bending and Forming Machines (Power)	2,206	781	642
Bending rolls, sheet and plate	767	271	303
Bending rolls, bars and shapes	139	67	53
Bending brakes	815	287	143
Rotary bending and forming machines	120	34	27
Bending machines, pipe, bar, and shapes	365	122	116
Wire and Strip Forming Machines	856	474	169
Hydraulic Presses	1,856	667	443
Vertical, single-action	1,085	467	223
Vertical, double and triple action	324	84	157
Horizontal	333	103	54
Extrusion (from hot billets)	25	◆	◆
Other (incl stretch and hydro-pneumatic)	89	◆	◆
Pneumatic Presses (except hydro-pneumatic)	210	104	41
Mechanical Presses (Power)	8,385	3,513	2,793
Inclinable, single-action (incl inclined)	5,549	2,519	1,734
Vertical, single-action: Straight-side (incl arch)	1,232	535	361
Vertical, single-action: Gap or C-frame	577	143	167
Vertical, single-action: Adjust. bed and horning	154	111	◆
Double and triple action	189	81	65
Dieing machines	28	◆	◆
Horizontal (incl bulldozers)	96	47	42
Multiple transfer (incl eyeletting)	74	11	45
Other	486	61	369
Punching and Shearing Machines	3,038	946	1,285
Punching machines (incl turret)	960	300	483
Plate and sheet shears	1,180	390	291
Bar and angle shears	352	134	137
Rotary shears, incl slitters	352	65	231
Nibbling machines	139	45	46
Other	55	12	17
Forging Machinery (except presses)	874	267	440
Hammers, steam or air	344	121	196
Hammers, mechanical (incl drop and helve)	259	99	148
Forging machines (headers) and rolls	114	35	64
Swaging machines	111	12	17
Other	46	◆	15
Riveting Machines (not portable)	1,400	637	298
Squeeze type	910	341	203
Rotary-vibrating type	85	49	◆
Spinning type	49	34	◆
Hammer type	356	213	93
Die Casting Machines	47	◆	◆
Hot chamber	27	◆	◆
Cold chamber	20	◆	◆
Plastics Molding Machines	400	194	◆
Injection	19	◆	◆
Compression	381	190	◆
Extrusion	◆	◆	◆
WELDING EQUIPMENT	14,471	7,911	433
Electric Welding Equipment	13,377	7,307	408
Power source: Motor-generator set	5,304	3,342	146
Transformer and rectifier	5,208	2,626	61
Arc-weld machines (not hand) incl automatic	1,122	518	18
Resistance welders: Spot	1,257	635	130
Gun (not hand)	89	33	◆
Seam	80	33	◆
Butt and flash	317	120	52
Gas Welding Machines (not hand)	83	31	◆
Flame Cutting Machines (not hand)	1,011	573	25
HEATING EQUIPMENT	5,272	2,001	673
Heat-treating furnaces	2,038	962	295
Atmosphere generators	141	37	◆
Stock-heating furnaces	1,482	455	221
Salt baths	229	133	21
Induction heating units	160	33	◆
Baking and drying ovens	1,186	373	133
Flame-hardening units	36	◆	◆
CLEANING AND FINISHING	1,630	631	115
Cleaning Equipment	1,379	544	96
Barrel finishing machines	390	225	62
Shot and abrasive blast	415	143	17
Parts washing machines (incl degreasers)	502	137	11
Pickling machines	72	39	◆
Plating Equipment	251	87	19
Machines	69	26	19
Barrels	182	61	◆
INDUSTRIAL TRUCKS (Power-Driven)	2,693	903	56
Lift (rider-type)	1,791	675	44
Truck-tractor	228	57	◆
Powered hand trucks	544	135	◆
Crane trucks	130	36	◆
OTHER SHOP EQUIPMENT	2,247	931	280
Balancing Machines	207	68	11
Air Compressors	2,011	842	269
Gear-Checking Machines	29	21	◆

271 plants — 104,495 employees

	Total Units	10 yr & over	Over 20 yr
METAL CUTTING	26,514	64%	19%
METAL FORMING	5531	67	22
OTHER EQUIPMENT	9052	62	12
TOTAL	41,097	64	18

• – Less than 10

All of the state of Maryland except the counties of Garrett and Allegany; all of the District of Columbia

	TOTAL	10-20 YEARS	OVER 20 YR
METAL-CUTTING MACHINES	26,514	11,925	5,006
Boring Machines	1,136	396	219
Horizontal boring, drilling, & milling	388	140	81
Vertical boring mills incl vert turret lathes	361	119	104
Precision, horizontal and vertical	217	64	18
Jig boring, horizontal and vertical	148	62	•
Other (except boring lathes)	22	11	•
Broaching Machines	99	39	•
Horizontal internal or combination	64	40	•
Horizontal surface	•	•	•
Vertical internal	18	12	•
Vertical surface or combination	11	•	•
Continuous horizontal & vertical	•	•	•
Other (incl rotary surface)	•	•	•
Contour Sawing and Filing	323	174	25
Cutoff Machines	1,440	701	187
Bandsaw (incl friction)	502	223	66
Abrasive disk	285	142	•
Hacksaws	420	216	80
Circular (incl friction)	225	113	25
Other	28	•	10
Drilling Machines	6,228	2,718	1,290
Sensitive	2,915	1,193	817
Upright: Single-spindle	1,928	894	234
Gang	444	198	49
Radial	595	278	130
Multi-spindle cluster, adjustable and fixed center	156	40	36
Automatic	27	•	10
Unit head & way type (not dial)	21	12	•
Deep-hole drills	33	17	•
Other (not incl special machines)	109	86	•
Gear Cutting and Finishing Machines	527	208	95
Hobbing machines, gear	176	56	40
Shapers, gear	151	77	•
Form-milling type (spur and bevel)	33	4	27
Bevel-gear cutters (not planer)	38	17	•
Grinders, gear tooth	45	33	•
Shavers, gear tooth	•	•	•
Burnishing and lapping	11	•	•
Chamfering, tooth pointing, tooth rounding	•	•	•
Other	61	•	17
Grinding Machines	5,051	2,404	1,000
External cylindrical: Plain	382	192	58
Universal	181	72	41
Internal cylindrical	155	63	44
Centerless: External	66	35	•
Internal	11	•	•
Surface: Rotary-table type	295	97	85
Reciprocating type	450	210	81
Disk, horizontal and vertical	117	38	26
Tool and cutter (incl drill)	1,112	482	192
Bench, floorstand, and snag	1,804	1,023	422
Jig grinders	16	•	•
Contour grinders	22	•	•
Abrasive belt (not polishing)	214	108	19
Other (except thread grinders)	226	76	30
Honing and Lapping	207	82	26
Honing: Internal (incl combination)	112	52	17
External and surface	•	•	•
Lapping: Surface	69	19	•
Cylindrical	11	•	•
Other (incl combination hone-lap)	13	•	•
Lathes	5,603	2,448	1,163
Bench, floor, lt-dy (incl turret attachment)	1,247	586	244
Engine, heavy-duty: Standard	1,369	515	293
Toolroom	622	284	144
Manufacturing and gap	76	27	39
Tracer	21	•	•
Turret lathes: Ram type	816	346	58
Saddle type	510	289	109
Auto chucking & between centers (single spindle)	135	41	43
Automatic chucking (multi-spindle)	•	•	•
Automatic screw machines (single spindle)	482	223	92
Automatic bar machines (multi-spindle)	110	37	43
Other (except spinning lathes)	211	96	96
Milling Machines	3,003	1,380	587
Bench type	232	126	42
Hand	185	94	20
Knee-type: Horizontal (plain & universal)	1,273	656	205
Vertical	664	224	130
Automatic & manufacturing	93	58	•
Ram type, swivel head	38	15	•
Bed (Lincoln) type, incl automatic rise and fall	147	77	29
Planer type (incl skin and spar)	33	13	12
Profilers, duplicators, diesinkers, engravers	200	68	22
Other (except thread milling)	138	49	35
Planers	173	77	56
Double housing	90	39	36
Openside and other	83	38	20
Pipe Cutting and Threading Machines	327	156	52
Polishing and Buffing Machines	1,238	663	115
Polishing stands (bench and floor)	519	290	42
Speed lathes	289	160	39
Abrasive-belt, disk, drum	398	209	34
Other	32	•	•
Shapers	540	234	147
Horizontal	404	186	100
Vertical, incl slotters & keyseaters	136	48	47
Threading (except pipe)	522	209	93
Tapping	215	74	28
Hobbing and milling	150	62	52
Die type	76	39	13
Grinders, thread	63	26	•
Rolling machines, thread	•	•	•
Other	13	•	•

	TOTAL	10-20 YEARS	OVER 20 YR
Electro-Erosion Machines (exc Tap disintegrators)	•	•	•
Ultrasonic Cutting Machines	•	•	•
Special Multi-Station Machines	•	•	•
In-line and transfer	•	•	•
Dial or rotary table	•	•	•
Automatic assembly (all types)	•	•	•
Other Metal-Cutting Machines	74	16	23
METAL-FORMING MACHINES	5,531	2,470	1,218
Bending and Forming Machines (Power)	1,185	513	153
Bending rolls, sheet and plate	304	120	61
Bending rolls, bars and shapes	58	24	•
Bending brakes	452	163	46
Rotary bending and forming machines	205	139	23
Bending machines, pipe, bar, and shapes	166	67	14
Wire and Strip Forming Machines	55	29	12
Hydraulic Presses	534	263	119
Vertical, single-action	388	183	102
Vertical, double and triple action	29	24	•
Horizontal	43	14	•
Extrusion (from hot billets)	•	•	•
Other (incl stretch and hydro-pneumatic)	73	42	•
Pneumatic Presses (except hydro-pneumatic)	186	58	26
Mechanical Presses (Power)	1,643	732	582
Inclinable, single-action (incl inclined)	721	420	130
Vertical, single-action: Straight-side (incl arch)	320	153	72
Vertical, single-action: Gap or C-frame	290	121	111
Vertical, single-action: Adjust. bed and horning	11	•	•
Double and triple action	26	•	•
Dieing machines	23	14	•
Horizontal (incl bulldozers)	•	•	•
Multiple transfer (incl eyeletting)	•	•	•
Other	265	36	175
Punching and Shearing Machines	1,169	484	309
Punching machines (incl turret)	298	144	76
Plate and sheet shears	486	209	85
Bar and angle shears	112	38	19
Rotary shears, incl slitters	149	27	99
Nibbling machines	64	38	14
Other	60	28	16
Forging Machinery (except presses)	150	92	44
Hammers, steam or air	74	39	28
Hammers, mechanical (incl drop and helve)	34	19	14
Forging machines (headers) and rolls	18	17	•
Swaging machines	18	14	•
Other	•	•	•
Riveting Machines (not portable)	639	264	53
Squeeze type	474	204	31
Rotary-vibrating type	31	17	•
Spinning type	44	19	18
Hammer type	90	24	•
Die Casting Machines	•	•	•
Hot chamber	•	•	•
Cold chamber	•	•	•
Plastics Molding Machines	29	15	•
Injection	11	•	•
Compression	18	•	•
Extrusion	•	•	•
WELDING EQUIPMENT	3,003	1,730	179
Electric Welding Equipment	2,869	1,647	166
Power source: Motor-generator set	1,507	848	104
Transformer and rectifier	572	361	13
Arc-weld machines (not hand) incl automatic	177	115	•
Resistance welders: Spot	522	268	37
Gun (not hand)	36	27	•
Seam	24	15	•
Butt and flash	31	13	•
Gas Welding Machines (not hand)	57	48	•
Flame Cutting Machines (not hand)	77	35	12
HEATING EQUIPMENT	1,438	668	301
Heat-treating furnaces	417	216	89
Atmosphere generators	20	11	•
Stock-heating furnaces	220	113	32
Salt baths	63	37	•
Induction heating units	73	25	•
Baking and drying ovens	635	266	172
Flame-hardening units	•	•	•
CLEANING AND FINISHING	985	520	117
Cleaning Equipment	874	479	111
Barrel finishing machines	122	61	•
Shot and abrasive blast	216	126	12
Parts washing machines (incl degreasers)	491	259	92
Pickling machines	45	33	•
Plating Equipment	111	41	•
Machines	65	27	•
Barrels	46	14	•
INDUSTRIAL TRUCKS (Power-Driven)	2,974	1,318	440
Lift (rider-type)	765	322	23
Truck-tractor	218	78	17
Powered hand trucks	1,666	747	339
Crane trucks	325	171	61
OTHER SHOP EQUIPMENT	662	304	33
Balancing Machines	28	•	•
Air Compressors	522	264	20
Gear-Checking Machines	120	36	13

Richmond

All of the states of Virginia, North Carolina, and South Carolina

417 plants — 110,970 employees

	Total Units	10 yr & over	Over 20 yr
METAL CUTTING	29,589	59%	13%
METAL FORMING	8581	58	19
OTHER EQUIPMENT	15,700	44	5
TOTAL	53,870	53	11

* – Less than 10

	TOTAL	10-20 YEARS	OVER 20 YR
METAL-CUTTING MACHINES	29,589	13,515	3,814
Boring Machines	1,012	455	145
Horizontal boring, drilling, & milling	464	177	62
Vertical boring mills incl vert turret lathes	424	239	81
Precision, horizontal and vertical	65	21	*
Jig boring, horizontal and vertical	59	18	*
Other (except boring lathes)	*	*	*
Broaching Machines	146	78	*
Horizontal internal or combination	74	45	*
Horizontal surface	13	*	*
Vertical internal	53	25	*
Vertical surface or combination	*	*	*
Continuous horizontal & vertical	*	*	*
Other (incl rotary surface)	*	*	*
Contour Sawing and Filing	323	120	*
Cutoff Machines	2,257	976	161
Bandsaw (incl friction)	872	403	20
Abrasive disk	459	159	24
Hacksaws	655	313	84
Circular (incl friction)	169	50	*
Other	102	51	24
Drilling Machines	6,583	2,891	720
Sensitive	1,977	856	263
Upright: Single-spindle	3,031	1,306	221
Gang	348	195	30
Radial	790	315	154
Multi-spindle cluster, adjustable and fixed center	235	101	40
Automatic	*	*	*
Unit head & way type (not dial)	17	17	*
Deep-hole drills	27	*	*
Other (not incl special machines)	158	92	12
Gear Cutting and Finishing Machines	642	273	110
Hobbing machines, gear	235	121	20
Shapers, gear	225	98	53
Form-milling type (spur and bevel)	35	*	18
Bevel-gear cutters (not planer)	107	50	16
Grinders, gear tooth	21	*	*
Shavers, gear tooth	*	*	*
Burnishing and lapping	*	*	*
Chamfering, tooth pointing, tooth rounding	*	*	*
Other	*	*	*
Grinding Machines	5,527	2,843	754
External cylindrical: Plain	314	168	57
Universal	184	79	*
Internal cylindrical	110	51	23
Centerless: External	65	22	21
Internal	*	*	*
Surface: Rotary-table type	152	62	32
Reciprocating type	552	239	79
Disk, horizontal and vertical	132	49	28
Tool and cutter (incl drill)	944	425	195
Bench, floorstand, and snag	2,223	1,228	260
Jig grinders	294	242	18
Contour grinders	44	29	*
Abrasive belt (not polishing)	309	130	20
Other (except thread grinders)	199	119	12
Honing and Lapping	161	46	*
Honing: Internal (incl combination)	128	35	*
External and surface	*	*	*
Lapping: Surface	16	*	*
Cylindrical	*	*	*
Other (incl combination hone-lap)	*	*	*
Lathes	6,163	2,776	1,121
Bench, floor, ll-dy (incl turret attachment)	1,643	580	232
Engine, heavy-duty: Standard	1,693	751	439
Toolroom	820	442	142
Manufacturing and gap	58	26	16
Tracer	200	90	45
Turret lathes: Ram type	688	403	91
Saddle type	293	155	38
Auto chucking & between centers (single spindle)	111	60	17
Automatic chucking (multi-spindle)	35	*	35
Automatic screw machines (single spindle)	489	191	44
Automatic bar machines (multi-spindle)	75	53	*
Other (except spinning lathes)	58	25	20
Milling Machines	2,669	1,152	267
Bench type	248	136	14
Hand	120	56	29
Knee-type: Horizontal (plain & universal)	1,053	458	147
Vertical	545	162	34
Automatic & manufacturing	111	62	*
Ram type, swivel head	111	47	*
Bed (Lincoln) type, incl automatic rise and fall	129	79	11
Planer type (incl skin and spar)	50	*	28
Profilers, duplicators, diesinkers, engravers	186	66	*
Other (except thread milling)	116	80	*
Planers	305	133	161
Double housing	220	79	133
Openside and other	85	54	28
Pipe Cutting and Threading Machines	433	244	45
Polishing and Buffing Machines	1,688	770	76
Polishing stands (bench and floor)	550	304	32
Speed lathes	335	197	*
Abrasive-belt, disk, drum	703	257	38
Other	100	12	*
Shapers	731	403	149
Horizontal	557	300	121
Vertical, incl slotters & keyseaters	174	103	28
Threading (except pipe)	863	351	94
Tapping	392	219	53
Hobbing and milling	94	65	*
Die type	80	48	19
Grinders, thread	17	13	*
Rolling machines, thread	*	*	*
Other	271	*	20

	TOTAL	10-20 YEARS	OVER 20 YR
Electro-Erosion Machines (exc Tap disintegrators)	*	*	*
Ultrasonic Cutting Machines	15	*	*
Special Multi-Station Machines	43	*	*
In-line and transfer	30	*	*
Dial or rotary table	*	*	*
Automatic assembly (all types)	*	*	*
Other Metal-Cutting Machines	28	*	*
METAL-FORMING MACHINES	8,581	3,380	1,624
Bending and Forming Machines (Power)	1,609	712	227
Bending rolls, sheet and plate	487	217	60
Bending rolls, bars and shapes	124	49	36
Bending brakes	557	189	89
Rotary bending and forming machines	77	37	22
Bending machines, pipe, bar, and shapes	364	220	20
Wire and Strip Forming Machines	293	23	148
Hydraulic Presses	657	228	90
Vertical, single-action	424	162	58
Vertical, double and triple action	54	11	*
Horizontal	59	21	23
Extrusion (from hot billets)	*	*	*
Other (incl stretch and hydro-pneumatic)	120	34	*
Pneumatic Presses (except hydro-pneumatic)	132	27	18
Mechanical Presses (Power)	2,430	1,010	455
Inclinable, single-action (incl inclined)	1,629	676	282
Vertical, single-action: Straight-side (incl arch)	270	167	36
Vertical, single-action: Gap or C-frame	275	101	93
Vertical, single-action: Adjust. bed and horning	145	44	*
Double and triple action	57	*	23
Dieing machines	15	*	*
Horizontal (incl bulldozers)	16	*	12
Multiple transfer (incl eyeletting)	21	12	*
Other	22	*	*
Punching and Shearing Machines	2,093	1,028	408
Punching machines (incl turret)	582	251	173
Plate and sheet shears	803	407	114
Bar and angle shears	355	142	80
Rotary shears, incl slitters	99	67	*
Nibbling machines	132	62	22
Other	122	99	13
Forging Machinery (except presses)	276	75	88
Hammers, steam or air	71	26	34
Hammers, mechanical (incl drop and helve)	90	*	20
Forging machines (headers) and rolls	113	45	32
Swaging machines	*	*	*
Other	*	*	*
Riveting Machines (not portable)	898	260	190
Squeeze type	480	184	38
Rotary-vibrating type	93	12	19
Spinning type	240	42	126
Hammer type	87	22	*
Die Casting Machines	165	*	*
Hot chamber	160	*	*
Cold chamber	*	*	*
Plastics Molding Machines	28	12	*
Injection	*	*	*
Compression	24	12	*
Extrusion	*	*	*
WELDING EQUIPMENT	8,015	3,376	240
Electric Welding Equipment	7,243	2,939	213
Power source: Motor-generator set	2,594	1,704	106
Transformer and rectifier	1,901	201	16
Arc-weld machines (not hand) incl automatic	1,388	548	*
Resistance welders: Spot	992	372	47
Gun (not hand)	248	72	*
Seam	44	*	*
Butt and flash	76	38	31
Gas Welding Machines (not hand)	146	68	*
Flame Cutting Machines (not hand)	626	369	27
HEATING EQUIPMENT	2,260	805	209
Heat-treating furnaces	861	437	139
Atmosphere generators	16	*	*
Stock-heating furnaces	103	54	*
Salt baths	137	47	*
Induction heating units	79	20	*
Baking and drying ovens	1,030	242	61
Flame-hardening units	34	*	*
CLEANING AND FINISHING	1,825	702	36
Cleaning Equipment	1,335	668	36
Barrel finishing machines	426	168	35
Shot and abrasive blast	368	261	*
Parts washing machines (incl degreasers)	514	218	*
Pickling machines	27	21	*
Plating Equipment	490	34	*
Machines	293	*	*
Barrels	197	28	*
INDUSTRIAL TRUCKS (Power-Driven)	2,266	775	182
Lift (rider-type)	640	110	*
Truck-tractor	220	41	*
Powered hand trucks	1,096	495	180
Crane trucks	310	129	*
OTHER SHOP EQUIPMENT	1,334	467	63
Balancing Machines	133	59	*
Air Compressors	1,173	398	57
Gear-Checking Machines	28	10	*

1023 plants — 205,907 employees

	Total Units	10 yr & over	Over 20 yr
METAL CUTTING	33,904	63%	17%
METAL FORMING	11,748	63	22
OTHER EQUIPMENT	22,949	44	4
TOTAL	68,601	56	13

◆ – Less than 10

All of the states of Georgia, Florida, Alabama, Mississippi, and Louisiana; Tennessee, east of a line that includes counties of Stewart, Houston, Humphreys, Perry, and Wayne

Atlanta — New Orleans

	TOTAL	10-20 YEARS	OVER 20 YR
METAL-CUTTING MACHINES	33,904	15,502	5,663
Boring Machines	1,284	478	411
Horizontal boring, drilling, & milling	481	131	169
Vertical boring mills incl vert turret lathes	518	224	218
Precision, horizontal and vertical	129	69	◆
Jig boring, horizontal and vertical	135	50	15
Other (except boring lathes)	21	◆	◆
Broaching Machines	160	89	16
Horizontal internal or combination	50	20	16
Horizontal surface	18	18	◆
Vertical internal	66	34	◆
Vertical surface or combination	19	17	◆
Continuous horizontal & vertical	◆	◆	◆
Other (incl rotary surface)	◆	◆	◆
Contour Sawing and Filing	370	219	14
Cutoff Machines	3,268	1,332	251
Bandsaw (incl friction)	1,135	527	64
Abrasive disk	525	125	21
Hacksaws	1,073	545	119
Circular (incl friction)	451	110	42
Other	84	25	◆
Drilling Machines	6,915	3,259	832
Sensitive	746	457	39
Upright: Single-spindle	4,044	1,969	456
Gang	537	162	55
Radial	992	476	247
Multi-spindle cluster, adjustable and fixed center	177	43	30
Automatic	18	◆	◆
Unit head & way type (not dial)	35	14	◆
Deep-hole drills	75	48	◆
Other (not incl special machines)	291	89	◆
Gear Cutting and Finishing Machines	613	282	201
Hobbing machines, gear	152	65	65
Shapers, gear	164	96	27
Form-milling type (spur and bevel)	93	31	47
Bevel-gear cutters (not planer)	50	23	19
Grinders, gear tooth	47	10	◆
Shavers, gear tooth	38	25	13
Burnishing and lapping	17	◆	12
Chamfering, tooth pointing, tooth rounding	◆	◆	◆
Other	50	31	18
Grinding Machines	6,156	3,217	522
External cylindrical: Plain	297	186	20
Universal	204	67	35
Internal cylindrical	169	117	18
Centerless: External	84	52	10
Internal	32	22	◆
Surface: Rotary-table type	194	104	12
Reciprocating type	466	215	47
Disk, horizontal and vertical	249	88	10
Tool and cutter (incl drill)	961	453	109
Bench, floorstand, and snag	2,860	1,647	252
Jig grinders	19	◆	◆
Contour grinders	32	21	◆
Abrasive belt (not polishing)	510	206	◆
Other (except thread grinders)	79	33	◆
Honing and Lapping	288	63	◆
Honing: Internal (incl combination)	149	39	◆
External and surface	◆	◆	◆
Lapping: Surface	106	◆	◆
Cylindrical	17	10	◆
Other (incl combination hone-lap)	14	◆	◆
Lathes	6,891	3,187	1,522
Bench, floor, lt-dy (incl turret attachment)	1,041	602	121
Engine, heavy-duty: Standard	2,751	1,206	917
Toolroom	948	368	100
Manufacturing and gap	99	81	◆
Tracer	50	◆	◆
Turret lathes: Ram type	967	493	158
Saddle type	448	208	59
Auto chucking & between centers (single spindle)	156	84	16
Automatic chucking (multi-spindle)	56	26	◆
Automatic screw machines (single spindle)	224	72	95
Automatic bar machines (multi-spindle)	78	46	◆
Other (except spinning lathes)	73	◆	40
Milling Machines	2,421	1,136	435
Bench type	152	49	34
Hand	187	82	53
Knee-type: Horizontal (plain & universal)	1,120	601	233
Vertical	401	173	10
Automatic & manufacturing	143	127	11
Ram type, swivel head	94	16	32
Bed (Lincoln) type, incl automatic rise and fall	66	37	14
Planer type (incl skin and spar)	76	10	44
Profilers, duplicators, diesinkers, engravers	139	30	◆
Other (except thread milling)	43	11	◆
Planers	504	180	245
Double housing	359	163	174
Openside and other	145	17	71
Pipe Cutting and Threading Machines	637	311	91
Polishing and Buffing Machines	1,358	583	103
Polishing stands (bench and floor)	761	345	69
Speed lathes	128	76	19
Abrasive-belt, disk, drum	363	117	15
Other	106	45	◆
Shapers	1,216	589	398
Horizontal	899	483	242
Vertical, incl slotters & keyseaters	317	106	156
Threading (except pipe)	1,011	443	270
Tapping	582	248	174
Hobbing and milling	59	11	30
Die type	208	84	51
Grinders, thread	54	36	◆
Rolling machines, thread	90	53	15
Other	18	11	◆

	TOTAL	10-20 YEARS	OVER 20 YR
Electro-Erosion Machines (exc Tap disintegrators)	◆	◆	◆
Ultrasonic Cutting Machines	◆	◆	◆
Special Multi-Station Machines	669	108	303
In-line and transfer	105	18	46
Dial or rotary table	360	34	221
Automatic assembly (all types)	204	56	36
Other Metal-Cutting Machines	135	26	47
METAL-FORMING MACHINES	11,748	4,823	2,576
Bending and Forming Machines (Power)	2,393	952	389
Bending rolls, sheet and plate	682	301	189
Bending rolls, bars and shapes	183	73	32
Bending brakes	907	323	114
Rotary bending and forming machines	145	38	37
Bending machines, pipe, bar, and shapes	476	217	17
Wire and Strip Forming Machines	112	48	◆
Hydraulic Presses	931	388	197
Vertical, single-action	616	281	122
Vertical, double and triple action	64	33	10
Horizontal	170	70	53
Extrusion (from hot billets)	27	◆	11
Other (incl stretch and hydro-pneumatic)	54	◆	◆
Pneumatic Presses (except hydro-pneumatic)	62	41	14
Mechanical Presses (Power)	4,300	2,059	828
Inclinable, single-action (incl inclined)	2,299	1,165	365
Vertical, single-action: Straight-side (incl arch)	729	369	141
Vertical, single-action: Gap or C-frame	709	233	156
Vertical, single-action: Adjust. bed and horning	184	103	56
Double and triple action	75	54	14
Dieing machines	◆	◆	◆
Horizontal (incl bulldozers)	66	24	36
Multiple transfer (incl eyeletting)	55	24	19
Other	179	87	41
Punching and Shearing Machines	2,500	940	828
Punching machines (incl turret)	718	179	390
Plate and sheet shears	855	349	204
Bar and angle shears	390	155	149
Rotary shears, incl slitters	148	52	50
Nibbling machines	218	104	33
Other	171	101	◆
Forging Machinery (except presses)	372	114	199
Hammers, steam or air	134	49	72
Hammers, mechanical (incl drop and helve)	71	46	16
Forging machines (headers) and rolls	102	13	74
Swaging machines	49	◆	24
Other	16	◆	13
Riveting Machines (not portable)	844	264	108
Squeeze type	325	159	43
Rotary-vibrating type	41	18	◆
Spinning type	63	◆	◆
Hammer type	415	79	50
Die Casting Machines	46	◆	◆
Hot chamber	14	◆	◆
Cold chamber	32	◆	◆
Plastics Molding Machines	188	17	◆
Injection	178	15	◆
Compression	10	◆	◆
Extrusion	◆	◆	◆
WELDING EQUIPMENT	14,530	5,981	183
Electric Welding Equipment	13,627	5,617	183
Power source: Motor-generator set	6,951	3,931	40
Transformer and rectifier	3,472	438	36
Arc-weld machines (not hand) incl automatic	1,215	326	◆
Resistance welders: Spot	1,599	711	96
Gun (not hand)	178	95	◆
Seam	123	61	◆
Butt and flash	89	55	◆
Gas Welding Machines (not hand)	143	56	◆
Flame Cutting Machines (not hand)	760	308	◆
HEATING EQUIPMENT	1,982	916	210
Heat-treating furnaces	735	355	60
Atmosphere generators	59	41	◆
Stock-heating furnaces	280	210	60
Salt baths	106	49	11
Induction heating units	151	33	5
Baking and drying ovens	605	196	74
Flame-hardening units	46	32	◆
CLEANING AND FINISHING	1,722	679	199
Cleaning Equipment	1,511	626	190
Barrel finishing machines	497	130	157
Shot and abrasive blast	601	338	19
Parts washing machines (incl degreasers)	358	117	14
Pickling machines	55	41	◆
Plating Equipment	211	53	◆
Machines	137	37	◆
Barrels	74	16	◆
INDUSTRIAL TRUCKS (Power-Driven)	2,532	810	64
Lift (rider-type)	1,629	520	55
Truck-tractor	386	112	◆
Powered hand trucks	323	79	◆
Crane trucks	194	99	◆
OTHER SHOP EQUIPMENT	2,183	899	239
Balancing Machines	371	102	43
Air Compressors	1,721	767	191
Gear-Checking Machines	91	30	◆

Cleveland

Northeast Ohio counties of Lorain, Cuyahoga, Lake, Ashtabula, Geauga, Trumbull, Mahoning, Portage, Summit, Medina, Richland, Ashland, Wayne, Stark, Morrow, Delaware, Knox, Licking, Holmes, Coshocton, Muskingum, Tuscarawas, Guernsey, and Noble

1128 plants — 318,983 employees

	Total Units	10 yr & over	Over 20 yr
METAL CUTTING	99,956	61%	17%
METAL FORMING	26,659	63	26
OTHER EQUIPMENT	33,757	46	10
TOTAL	160,372	58	15

• – Less than 10

	TOTAL	10-20 YEARS	OVER 20 YR
METAL-CUTTING MACHINES	99,956	44,579	16,578
Boring Machines	4,081	1,680	764
Horizontal boring, drilling, & milling	1,311	500	298
Vertical boring mills incl vert turret lathes	1,062	416	398
Precision, horizontal and vertical	1,143	514	22
Jig boring, horizontal and vertical	469	207	37
Other (except boring lathes)	96	43	•
Broaching Machines	862	415	181
Horizontal internal or combination	393	233	105
Horizontal surface	89	12	16
Vertical internal	195	111	39
Vertical surface or combination	152	47	15
Continuous horizontal & vertical	23	10	•
Other (incl rotary surface)	10	•	•
Contour Sawing and Filing	789	310	72
Cutoff Machines	4,779	1,959	573
Bandsaw (incl friction)	1,822	770	154
Abrasive disk	603	246	22
Hacksaws	1,441	713	231
Circular (incl friction)	712	203	127
Other	201	27	39
Drilling Machines	18,831	9,077	3,046
Sensitive	3,073	1,799	253
Upright: Single-spindle	7,631	3,406	1,533
Gang	2,516	1,316	378
Radial	2,671	1,468	436
Multi-spindle cluster, adjustable and fixed center	1,456	654	144
Automatic	462	81	151
Unit head & way type (not dial)	166	56	12
Deep-hole drills	108	28	14
Other (not incl special machines)	748	269	125
Gear Cutting and Finishing Machines	3,566	1,360	981
Hobbing machines, gear	1,410	559	301
Shapers, gear	728	386	103
Form-milling type (spur and bevel)	491	134	332
Bevel-gear cutters (not planer)	408	133	120
Grinders, gear tooth	66	23	•
Shavers, gear tooth	194	59	11
Burnishing and lapping	102	36	•
Chamfering, tooth pointing, tooth rounding	76	28	26
Other	91	•	80
Grinding Machines	21,544	9,083	2,262
External cylindrical: Plain	2,297	1,147	259
Universal	709	417	81
Internal cylindrical	1,175	511	124
Centerless: External	1,002	535	61
Internal	107	53	•
Surface: Rotary-table type	1,046	478	139
Reciprocating type	2,024	907	166
Disk, horizontal and vertical	557	252	90
Tool and cutter (incl drill)	4,793	2,009	477
Bench, floorstand, and snag	5,337	2,630	721
Jig grinders	70	19	11
Contour grinders	273	66	65
Abrasive belt (not polishing)	735	327	15
Other (except thread grinders)	1,419	532	51
Honing and Lapping	1,004	381	16
Honing: Internal (incl combination)	541	238	•
External and surface	35	21	•
Lapping: Surface	161	68	•
Cylindrical	139	27	•
Other (incl combination hone-lap)	128	27	•
Lathes	21,612	9,787	3,897
Bench, floor, ft-dy (incl turret attachment)	2,332	1,105	410
Engine, heavy-duty: Standard	2,989	1,452	997
Toolroom	2,131	873	398
Manufacturing and gap	246	79	79
Tracer	280	33	•
Turret lathes: Ram type	4,090	1,849	525
Saddle type	2,578	1,444	348
Auto chucking & between centers (single spindle)	1,122	347	70
Automatic chucking (multi-spindle)	518	221	82
Automatic screw machines (single spindle)	2,246	679	384
Automatic bar machines (multi-spindle)	2,358	1,581	146
Other (except spinning lathes)	722	124	458
Milling Machines	10,352	4,397	1,746
Bench type	319	161	23
Hand	1,489	897	209
Knee-type: Horizontal (plain & universal)	3,559	1,679	688
Vertical	1,916	776	154
Automatic & manufacturing	496	256	38
Ram type, swivel head	221	83	•
Bed (Lincoln) type, incl automatic rise and fall	474	217	57
Planer type (incl skin and spar)	176	56	68
Profilers, duplicators, diesinkers, engravers	778	294	38
Other (except thread milling)	924	178	471
Planers	843	292	469
Double housing	547	200	312
Openside and other	296	92	157
Pipe Cutting and Threading Machines	750	305	84
Polishing and Buffing Machines	4,369	1,877	656
Polishing stands (bench and floor)	2,283	865	355
Speed lathes	854	449	199
Abrasive-belt, disk, drum	985	436	76
Other	247	127	26
Shapers	2,310	1,065	806
Horizontal	1,905	871	655
Vertical, incl slotters & keyseaters	405	194	151
Threading (except pipe)	3,256	1,507	869
Tapping	1,049	566	158
Hobbing and milling	561	273	171
Die type	309	116	227
Grinders, thread	377	237	47
Rolling machines, thread	782	274	253
Other	98	41	13

	TOTAL	10-20 YEARS	OVER 20 YR
Electro-Erosion Machines (exc Tap disintegrators)	21	•	•
Ultrasonic Cutting Machines	•	•	•
Special Multi-Station Machines	666	41	•
In-line and transfer	312	•	•
Dial or rotary table	260	18	•
Automatic assembly (all types)	94	18	•
Other Metal-Cutting Machines	319	37	148
METAL-FORMING MACHINES	26,659	9,799	6,903
Bending and Forming Machines (Power)	2,814	1,077	586
Bending rolls, sheet and plate	729	286	159
Bending rolls, bars and shapes	136	63	50
Bending brakes	1,322	528	283
Rotary bending and forming machines	254	67	48
Bending machines, pipe, bar, and shapes	373	133	46
Wire and Strip Forming Machines	633	168	123
Hydraulic Presses	2,218	1,141	270
Vertical, single-action	1,613	1,000	177
Vertical, double and triple action	166	64	38
Horizontal	174	19	44
Extrusion (from hot billets)	112	22	•
Other (incl stretch and hydro-pneumatic)	153	36	•
Pneumatic Presses (except hydro-pneumatic)	469	321	•
Mechanical Presses (Power)	12,326	4,084	3,666
Inclinable, single-action (incl inclined)	5,396	2,218	1,552
Vertical, single-action: Straight-side (incl arch)	2,984	812	858
Vertical, single-action: Gap or C-frame	1,602	435	493
Vertical, single-action: Adjust. bed and horning	874	314	248
Double and triple action	249	75	74
Dieing machines	93	33	15
Horizontal (incl bullsizers)	195	46	110
Multiple transfer (incl eyeletting)	16	•	•
Other	917	151	316
Punching and Shearing Machines	3,391	1,162	1,063
Punching machines (incl turret)	760	231	367
Plate and sheet shears	1,158	449	307
Bar and angle shears	486	152	166
Rotary shears, incl slitters	331	128	106
Nibbling machines	269	123	27
Other	387	79	90
Forging Machinery (except presses)	2,108	794	1,011
Hammers, steam or air	493	209	218
Hammers, mechanical (incl drop and helve)	245	45	195
Forging machines (headers) and rolls	1,023	372	523
Swaging machines	87	49	29
Other	260	119	46
Riveting Machines (not portable)	2,199	966	161
Squeeze type	819	332	78
Rotary-vibrating type	641	221	13
Spinning type	233	155	36
Hammer type	506	258	34
Die Casting Machines	32	•	•
Hot chamber	22	•	•
Cold chamber	10	•	•
Plastics Molding Machines	469	81	11
Injection	121	42	•
Compression	334	39	11
Extrusion	14	•	•
WELDING EQUIPMENT	14,566	5,284	1,195
Electric Welding Equipment	13,709	4,910	1,155
Power source: Motor-generator set	4,297	2,107	447
Transformer and rectifier	3,721	694	177
Arc-weld machines (not hand) incl automatic	1,539	568	16
Resistance welders: Spot	3,300	1,246	395
Gun (not hand)	236	72	•
Seam	128	32	25
Butt and flash	488	191	89
Gas Welding Machines (not hand)	140	78	•
Flame Cutting Machines (not hand)	717	296	40
HEATING EQUIPMENT	6,424	2,592	853
Heat-treating furnaces	2,778	1,280	429
Atmosphere generators	156	57	•
Stock-heating furnaces	829	206	155
Salt baths	626	174	64
Induction heating units	427	71	22
Baking and drying ovens	1,522	795	177
Flame-hardening units	86	29	•
CLEANING AND FINISHING	4,204	1,369	865
Cleaning Equipment	3,456	915	832
Barrel finishing machines	1,462	280	683
Shot and abrasive blast	681	249	55
Parts washing machines (incl degreasers)	1,206	336	64
Pickling machines	107	50	30
Plating Equipment	748	454	33
Machines	335	199	25
Barrels	413	255	•
INDUSTRIAL TRUCKS (Power-Driven)	4,981	1,541	182
Lift (rider-type)	3,030	1,017	120
Truck-tractor	583	135	20
Powered hand trucks	1,215	337	•
Crane trucks	153	52	12
OTHER SHOP EQUIPMENT	3,582	1,460	341
Balancing Machines	469	126	•
Air Compressors	2,581	1,101	257
Gear-Checking Machines	532	233	79

352 plants — 95,173 employees

	Total Units	10 yr & over	Over 20 yr
METAL CUTTING	27,130	54%	14%
METAL FORMING	8538	54	13
OTHER EQUIPMENT	9495	44	5
TOTAL	45,163	52	12

• — Less than 10

Northwest Ohio counties of Williams, Fulton, Lucas, Defiance, Henry, Wood, Ottawa, Sandusky, Erie, Seneca, Huron, Wyandot, Crawford, Marion, Hancock, Hardin, Paulding, Putnam, Van Wert, Allen, Mercer, and Auglaize

	TOTAL	10-20 YEARS	OVER 20 YR
METAL-CUTTING MACHINES	**27,130**	**11,026**	**3,755**
Boring Machines	**1,530**	**463**	**166**
Horizontal boring, drilling, & milling	422	195	67
Vertical boring mills incl vert turret lathes	316	119	76
Precision, horizontal and vertical	675	107	18
Jig boring, horizontal and vertical	81	34	•
Other (except boring lathes)	36	•	•
Broaching Machines	**473**	**175**	**49**
Horizontal internal or combination	141	72	35
Horizontal surface	43	•	•
Vertical internal	174	67	•
Vertical surface or combination	73	36	•
Continuous horizontal & vertical	40	•	•
Other (incl rotary surface)	•	•	•
Contour Sawing and Filing	**208**	**72**	**•**
Cutoff Machines	**1,111**	**457**	**75**
Bandsaw (incl friction)	450	197	17
Abrasive disk	145	73	•
Hacksaws	278	132	33
Circular (incl friction)	188	53	10
Other	50	•	10
Drilling Machines	**4,873**	**2,105**	**973**
Sensitive	598	144	98
Upright: Single-spindle	2,272	1,067	478
Gang	548	282	128
Radial	636	348	111
Multi-spindle cluster, adjustable and fixed center	406	152	122
Automatic	96	45	•
Unit head & way type (not dial)	62	28	12
Deep-hole drills	23	20	•
Other (not incl special machines)	232	19	24
Gear Cutting and Finishing Machines	**1,120**	**431**	**189**
Hobbing machines, gear	541	194	97
Shapers, gear	237	108	20
Form-milling type (spur and bevel)	27	•	25
Bevel-gear cutters (not planer)	59	32	22
Grinders, gear tooth	33	19	12
Shavers, gear tooth	100	35	•
Burnishing and lapping	47	•	•
Chamfering, tooth pointing, tooth rounding	71	37	12
Other	•	•	•
Grinding Machines	**6,259**	**2,586**	**775**
External cylindrical: Plain	424	210	57
Universal	209	78	10
Internal cylindrical	340	156	55
Centerless: External	208	77	26
Internal	93	30	31
Surface: Rotary-table type	432	180	37
Reciprocating type	517	196	68
Disk, horizontal and vertical	234	72	31
Tool and cutter (incl drill)	1,151	376	175
Bench, floorstand, and snag	1,390	625	165
Jig grinders	19	•	•
Contour grinders	210	•	•
Abrasive belt (not polishing)	277	88	•
Other (except thread grinders)	755	491	112
Honing and Lapping	**527**	**181**	**37**
Honing: Internal (incl combination)	248	76	•
External and surface	•	•	•
Lapping: Surface	129	69	•
Cylindrical	92	33	21
Other (incl combination hone-lap)	52	•	•
Lathes	**4,888**	**2,374**	**792**
Bench, floor, lt-dy (incl turret attachment)	407	223	57
Engine, heavy-duty: Standard	811	389	208
Toolroom	723	286	120
Manufacturing and gap	359	199	98
Tracer	91	10	•
Turret lathes: Ram type	638	336	82
Saddle type	426	299	48
Auto chucking & between centers (single spindle)	250	100	21
Automatic chucking (multi-spindle)	252	84	19
Automatic screw machines (single spindle)	411	149	50
Automatic bar machines (multi-spindle)	313	178	77
Other (except spinning lathes)	207	121	12
Milling Machines	**2,342**	**1,077**	**362**
Bench type	73	35	•
Hand	260	133	70
Knee-type: Horizontal (plain & universal)	717	358	135
Vertical	451	179	59
Automatic & manufacturing	251	154	37
Ram type, swivel head	68	32	•
Bed (Lincoln) type, incl automatic rise and fall	53	21	•
Planer type (incl skin and spar)	61	10	28
Profilers, duplicators, diesinkers, engravers	226	15	•
Other (except thread milling)	182	70	21
Planers	**210**	**82**	**71**
Double housing	130	59	46
Openside and other	80	23	25
Pipe Cutting and Threading Machines	**174**	**66**	**•**
Polishing and Buffing Machines	**1,843**	**663**	**65**
Polishing stands (bench and floor)	796	312	48
Speed lathes	298	31	11
Abrasive-belt, disk, drum	467	238	•
Other	282	82	•
Shapers	**508**	**210**	**135**
Horizontal	407	175	101
Vertical, incl slotters & keyseaters	101	35	34
Threading (except pipe)	**486**	**120**	**33**
Tapping	315	45	12
Hobbing and milling	33	15	11
Die type	50	18	10
Grinders, thread	35	26	•
Rolling machines, thread	13	•	•
Other	40	14	•

	TOTAL	10-20 YEARS	OVER 20 YR
Electro-Erosion Machines (exc Tap disintegrators)	•	•	•
Ultrasonic Cutting Machines	10	•	•
Special Multi-Station Machines	**391**	**15**	**•**
In-line and transfer	280	•	•
Dial or rotary table	64	15	•
Automatic assembly (all types)	47	•	•
Other Metal-Cutting Machines	**173**	**19**	**17**
METAL-FORMING MACHINES	**8,538**	**3,538**	**1,102**
Bending and Forming Machines (Power)	**809**	**348**	**63**
Bending rolls, sheet and plate	190	71	34
Bending rolls, bars and shapes	25	14	•
Bending brakes	341	135	19
Rotary bending and forming machines	18	16	•
Bending machines, pipe, bar, and shapes	235	112	•
Wire and Strip Forming Machines	**46**	**18**	**•**
Hydraulic Presses	**459**	**185**	**65**
Vertical, single-action	276	110	47
Vertical, double and triple action	108	67	•
Horizontal	31	•	13
Extrusion (from hot billets)	•	•	•
Other (incl stretch and hydro-pneumatic)	44	•	•
Pneumatic Presses (except hydro-pneumatic)	**145**	**34**	**19**
Mechanical Presses (Power)	**5,140**	**2,490**	**628**
Inclinable, single-action (incl inclined)	2,851	1,647	233
Vertical, single-action: Straight-side (incl arch)	795	292	156
Vertical, single-action: Gap or C-frame	977	311	170
Vertical, single-action: Adjust. bed and horning	115	99	•
Double and triple action	85	53	21
Dieing machines	44	19	•
Horizontal (incl bulldozers)	94	36	37
Multiple transfer (incl eyeletting)	82	14	•
Other	97	19	•
Punching and Shearing Machines	**715**	**239**	**174**
Punching machines (incl turret)	169	19	76
Plate and sheet shears	297	135	37
Bar and angle shears	65	34	17
Rotary shears, incl slitters	61	19	17
Nibbling machines	102	26	27
Other	21	•	•
Forging Machinery (except presses)	**153**	**28**	**74**
Hammers, steam or air	24	10	14
Hammers, mechanical (incl drop and helve)	87	11	37
Forging machines (headers) and rolls	33	•	18
Swaging machines	•	•	•
Other	•	•	•
Riveting Machines (not portable)	**809**	**132**	**77**
Squeeze type	196	33	30
Rotary-vibrating type	84	10	•
Spinning type	151	57	11
Hammer type	378	32	33
Die Casting Machines	**262**	**64**	**•**
Hot chamber	211	63	•
Cold chamber	51	•	•
Plastics Molding Machines	•	•	•
Injection	•	•	•
Compression	•	•	•
Extrusion	•	•	•
WELDING EQUIPMENT	**3,711**	**1,739**	**95**
Electric Welding Equipment	**3,550**	**1,674**	**93**
Power source: Motor-generator set	1,500	1,021	51
Transformer and rectifier	854	308	•
Arc-weld machines (not hand) incl automatic	253	106	14
Resistance welders: Spot	835	204	23
Gun (not hand)	41	•	•
Seam	20	12	•
Butt and flash	47	22	•
Gas Welding Machines (not hand)	**26**	**•**	**•**
Flame Cutting Machines (not hand)	**135**	**63**	**•**
HEATING EQUIPMENT	**1,706**	**609**	**147**
Heat-treating furnaces	669	322	69
Atmosphere generators	42	31	•
Stock-heating furnaces	304	59	56
Salt baths	93	61	•
Induction heating units	355	53	•
Baking and drying ovens	181	49	15
Flame-hardening units	62	34	•
CLEANING AND FINISHING	**1,438**	**544**	**94**
Cleaning Equipment	**1,230**	**427**	**94**
Barrel finishing machines	428	194	61
Shot and abrasive blast	181	50	14
Parts washing machines (incl degreasers)	603	176	19
Pickling machines	18	•	•
Plating Equipment	**208**	**117**	**•**
Machines	153	105	•
Barrels	55	12	•
INDUSTRIAL TRUCKS (Power-Driven)	**1,518**	**481**	**36**
Lift (rider-type)	889	322	22
Truck-tractor	208	67	•
Powered hand trucks	366	57	12
Crane trucks	55	35	•
OTHER SHOP EQUIPMENT	**1,122**	**374**	**70**
Balancing Machines	**187**	**27**	**•**
Air Compressors	**728**	**309**	**60**
Gear-Checking Machines	**207**	**38**	**•**

Cincinnati — Louisville

Ohio south of a line that includes counties of Darke, Shelby, Logan, Union, Franklin, Fairfield, Perry, Morgan, and Athens; Kentucky east of a line that includes counties of Jefferson, Bullitt, Nelson, Larue, Green, Metcalfe, and Monroe

917 plants — 283,816 employees

	Total Units	10 yr & over	Over 20 yr
METAL CUTTING	81,038	64%	23%
METAL FORMING	25,801	61	24
OTHER EQUIPMENT	29,216	46	9
TOTAL	136,055	59	20

• – Less than 10

	TOTAL	10-20 YEARS	OVER 20 YR
METAL-CUTTING MACHINES	81,038	33,446	18,314
Boring Machines	3,182	1,224	585
Horizontal boring, drilling, & milling	990	446	141
Vertical boring mills incl vert turret lathes	771	340	218
Precision, horizontal and vertical	904	233	118
Jig boring, horizontal and vertical	408	172	63
Other (except boring lathes)	109	33	45
Broaching Machines	757	304	104
Horizontal internal or combination	239	116	60
Horizontal surface	15	•	•
Vertical internal	120	59	•
Vertical surface or combination	113	30	21
Continuous horizontal & vertical	•	•	•
Other (incl rotary surface)	263	92	18
Contour Sawing and Filing	830	413	81
Cutoff Machines	3,823	1,595	486
Bandsaw (incl friction)	1,594	623	174
Abrasive disk	517	215	19
Hacksaws	1,194	577	247
Circular (incl friction)	259	109	30
Other	259	71	16
Drilling Machines	17,258	7,576	4,120
Sensitive	4,717	1,711	1,505
Upright: Single-spindle	7,836	3,689	1,610
Gang	1,264	706	221
Radial	1,951	983	385
Multi-spindle cluster, adjustable and fixed center	767	250	225
Automatic	77	•	•
Unit head & way type (not dial)	69	12	•
Deep-hole drills	61	11	•
Other (not incl special machines)	516	206	156
Gear Cutting and Finishing Machines	1,997	647	552
Hobbing machines, gear	936	289	248
Shapers, gear	401	162	67
Form-milling type (spur and bevel)	174	13	146
Bevel-gear cutters (not planer)	117	46	34
Grinders, gear tooth	98	51	17
Shavers, gear tooth	90	45	•
Burnishing and Tapping	32	13	•
Chamfering, tooth pointing, tooth rounding	98	24	14
Other	51	•	19
Grinding Machines	18,281	7,238	4,674
External cylindrical: Plain	1,073	454	153
Universal	486	247	39
Internal cylindrical	535	293	79
Centerless: External	522	254	77
Internal	85	35	10
Surface: Rotary-table type	982	412	171
Reciprocating type	2,417	1,126	387
Disk, horizontal and vertical	575	182	120
Tool and cutter (incl drill)	5,175	1,445	2,473
Bench, floorstand, and snag	4,845	2,364	956
Jig grinders	110	20	•
Contour grinders	124	27	17
Abrasive belt (not polishing)	860	260	108
Other (except thread grinders)	492	119	80
Honing and Lapping	967	278	175
Honing: Internal (incl combination)	448	135	57
External and surface	61	18	•
Lapping: Surface	230	58	98
Cylindrical	205	61	17
Other (incl combination hone-lap)	23	•	•
Lathes	15,724	7,504	3,391
Bench, floor, ll-dy (incl turret attachment)	2,149	902	492
Engine, heavy-duty: Standard	3,965	1,928	1,038
Toolroom	1,282	560	279
Manufacturing and gap	229	84	49
Tracer	117	30	•
Turret lathes: Ram type	2,553	1,599	345
Saddle type	1,292	895	73
Auto chucking & between centers (single spindle)	429	172	44
Automatic chucking (multi-spindle)	534	134	147
Automatic screw machines (single spindle)	2,281	851	645
Automatic bar machines (multi-spindle)	622	257	142
Other (except spinning lathes)	271	112	114
Milling Machines	7,962	3,471	1,933
Bench type	299	95	163
Hand	1,034	442	350
Knee-type: Horizontal (plain & universal)	2,923	1,371	825
Vertical	1,557	677	158
Automatic & manufacturing	648	307	115
Ram type, swivel head	163	36	•
Bed (Lincoln) type, incl automatic rise and fall	255	138	49
Planer type (incl skin and spar)	156	39	66
Profilers, duplicators, diesinkers, engravers	645	237	155
Other (except thread milling)	282	129	45
Planers	741	278	291
Double housing	541	226	224
Openside and other	200	44	67
Pipe Cutting and Threading Machines	631	272	96
Polishing and Buffing Machines	3,832	1,252	632
Polishing stands (bench and floor)	2,247	579	433
Speed lathes	502	274	163
Abrasive-belt, disk, drum	672	292	25
Other	413	107	11
Shapers	1,580	583	541
Horizontal	1,148	435	431
Vertical, incl slotters & keyseaters	352	148	110
Threading (except pipe)	1,597	579	376
Tapping	989	266	283
Hobbing and milling	159	90	32
Die type	134	77	27
Grinders, thread	92	67	•
Rolling machines, thread	187	72	17
Other	36	•	11

	TOTAL	10-20 YEARS	OVER 20 YR
Electro-Erosion Machines (exc Tap disintegrators)	13	•	•
Ultrasonic Cutting Machines	•	•	•
Special Multi-Station Machines	1,372	54	64
In-line and transfer	1,100	•	•
Dial or rotary table	157	31	41
Automatic assembly (all types)	115	23	23
Other Metal-Cutting Machines	563	186	213
METAL-FORMING MACHINES	25,801	9,391	6,279
Bending and Forming Machines (Power)	4,364	1,562	752
Bending rolls, sheet and plate	1,757	600	374
Bending rolls, bars and shapes	431	91	53
Bending brakes	1,586	681	234
Rotary bending and forming machines	194	66	28
Bending machines, pipe, bar, and shapes	396	124	63
Wire and Strip Forming Machines	674	127	63
Hydraulic Presses	1,201	519	155
Vertical, single-action	914	397	124
Vertical, double and triple action	108	54	•
Horizontal	65	28	•
Extrusion (from hot billets)	69	18	18
Other (incl stretch and hydro-pneumatic)	45	22	•
Pneumatic Presses (except hydro-pneumatic)	103	51	•
Mechanical Presses (Power)	12,830	4,618	3,681
Inclinable, single-action (incl inclined)	5,291	2,136	1,451
Vertical, single-action: Straight-side (incl arch)	2,566	902	808
Vertical, single-action: Gap or C-frame	2,227	695	679
Vertical, single-action: Adjust. bed and horning	846	449	141
Double and triple action	82	19	35
Dieing machines	76	33	•
Horizontal (incl bulldozers)	112	44	34
Multiple transfer (incl eyeletting)	76	•	•
Other	1,554	338	496
Punching and Shearing Machines	3,513	1,389	930
Punching machines (incl turret)	823	257	327
Plate and sheet shears	1,417	602	349
Bar and angle shears	294	117	74
Rotary shears, incl slitters	408	174	75
Nibbling machines	403	144	95
Other	168	95	10
Forging Machinery (except presses)	428	141	137
Hammers, steam or air	70	•	53
Hammers, mechanical (incl drop and helve)	97	28	58
Forging machines (headers) and rolls	155	82	17
Swaging machines	102	25	•
Other	•	•	•
Riveting Machines (not portable)	2,371	878	572
Squeeze type	674	259	115
Rotary-vibrating type	497	75	218
Spinning type	220	53	75
Hammer type	980	491	164
Die Casting Machines	97	21	•
Hot chamber	87	19	•
Cold chamber	10	•	•
Plastics Molding Machines	220	85	10
Injection	43	24	•
Compression	177	61	•
Extrusion	•	•	•
WELDING EQUIPMENT	14,580	5,634	1,128
Electric Welding Equipment	13,983	5,352	1,076
Power source: Motor-generator set	4,833	2,464	375
Transformer and rectifier	3,598	1,084	65
Arc-weld machines (not hand) incl automatic	1,066	373	51
Resistance welders: Spot	3,810	1,173	524
Gun (not hand)	239	88	24
Seam	251	103	19
Butt and flash	186	67	18
Gas Welding Machines (not hand)	46	22	•
Flame Cutting Machines (not hand)	551	260	50
HEATING EQUIPMENT	3,368	1,432	397
Heat-treating furnaces	1,475	662	260
Atmosphere generators	61	15	•
Stock-heating furnaces	271	116	25
Salt baths	407	175	29
Induction heating units	276	140	•
Baking and drying ovens	802	289	67
Flame-hardening units	76	35	
CLEANING AND FINISHING	3,044	1,126	334
Cleaning Equipment	2,431	846	289
Barrel finishing machines	779	234	205
Shot and abrasive blast	530	222	28
Parts washing machines (incl degreasers)	1,038	352	56
Pickling machines	84	38	•
Plating Equipment	613	280	45
Machines	308	115	16
Barrels	305	165	29
INDUSTRIAL TRUCKS (Power-Driven)	5,354	1,657	336
Lift (rider-type)	2,118	581	62
Truck-tractor	617	121	120
Powered hand trucks	2,419	882	113
Crane trucks	200	73	41
OTHER SHOP EQUIPMENT	2,870	1,137	302
Balancing Machines	434	164	27
Air Compressors	2,075	873	225
Gear-Checking Machines	361	100	50

1798 plants — 621,172 employees

	Total Units	10 yr & over	Over 20 yr
METAL CUTTING	180,682	55%	16%
METAL FORMING	47,726	59	28
OTHER EQUIPMENT	57,937	40	12
TOTAL	286,345	53	17

◆ – Less than 10

Michigan east of a line that includes counties of Cheboygan, Otsego, Crawford, Roscommon, Clare, Isabella, Gratiot, Clinton, Ingham, Jackson, and Hillsdale

Detroit

	TOTAL	10-20 YEARS	OVER 20 YR
METAL-CUTTING MACHINES	180,682	71,420	28,418
Boring Machines	8,584	2,804	829
Horizontal boring, drilling, & milling	2,569	822	303
Vertical boring mills incl vert turret lathes	934	388	194
Precision, horizontal and vertical	3,229	993	150
Jig boring, horizontal and vertical	1,307	379	128
Other (except boring lathes)	545	222	54
Broaching Machines	2,211	784	374
Horizontal internal or combination	451	213	140
Horizontal surface	261	83	35
Vertical internal	450	145	56
Vertical surface or combination	867	323	108
Continuous horizontal & vertical	33	◆	12
Other (incl rotary surface)	149	20	23
Contour Sawing and Filing	1,517	538	198
Cutoff Machines	7,846	3,129	834
Bandsaw (incl friction)	3,510	1,352	379
Abrasive disk	958	401	65
Hacksaws	1,836	869	214
Circular (incl friction)	738	287	58
Other	804	220	118
Drilling Machines	35,316	13,875	6,579
Sensitive	6,368	2,457	1,293
Upright: Single-spindle	16,043	6,680	3,009
Gang	3,261	1,614	606
Radial	2,961	1,381	506
Multi-spindle cluster, adjustable and fixed center	1,266	402	238
Automatic	758	238	11
Unit head & way type (not dial)	637	177	103
Deep-hole drills	245	110	22
Other (not incl special machines)	3,777	816	791
Gear Cutting and Finishing Machines	7,825	2,428	1,405
Hobbing machines, gear	2,191	740	491
Shapers, gear	1,440	532	265
Form-milling type (spur and bevel)	94	17	48
Bevel-gear cutters (not planer)	1,556	313	305
Grinders, gear tooth	809	451	38
Shavers, gear tooth	664	168	73
Burnishing and lapping	500	77	77
Chamfering, tooth pointing, tooth rounding	361	79	68
Other	210	51	40
Grinding Machines	44,654	18,666	7,020
External cylindrical: Plain	4,828	2,161	830
Universal	2,049	911	352
Internal cylindrical	2,975	1,438	377
Centerless: External	2,807	1,212	237
Internal	337	193	10
Surface: Rotary-table type	3,116	1,251	364
Reciprocating type	5,147	2,396	996
Disk, horizontal and vertical	1,247	416	282
Tool and cutter (incl drill)	9,286	3,735	2,036
Bench, floorstand, and snag	7,662	3,143	1,331
Jig grinders	300	49	20
Contour grinders	381	159	27
Abrasive belt (not polishing)	1,376	578	90
Other (except thread grinders)	3,143	1,024	468
Honing and Lapping	2,945	1,084	231
Honing: Internal (incl combination)	1,294	416	60
External and surface	223	98	◆
Lapping: Surface	639	262	53
Cylindrical	420	142	75
Other (incl combination hone-lap)	369	166	41
Lathes	28,241	13,273	4,812
Bench, floor, ll-dy (incl turret attachment)	3,149	1,636	361
Engine, heavy-duty: Standard	4,793	2,257	1,186
Toolroom	3,815	1,759	578
Manufacturing and gap	744	362	137
Tracer	275	52	◆
Turret lathes: Ram type	2,730	1,641	317
Saddle type	1,696	1,040	226
Auto chucking & between centers (single spindle)	1,770	540	299
Automatic chucking (multi-spindle)	2,197	650	422
Automatic screw machines (single spindle)	3,014	1,436	402
Automatic bar machines (multi-spindle)	2,923	1,628	625
Other (except spinning lathes)	1,135	272	250
Milling Machines	15,269	6,986	2,583
Bench type	315	167	50
Hand	1,816	1,054	394
Knee-type: Horizontal (plain & universal)	4,481	2,176	759
Vertical	3,241	1,534	289
Automatic & manufacturing	1,550	747	328
Ram type, swivel head	581	112	11
Bed (Lincoln) type, incl automatic rise and fall	739	409	110
Planer type (incl skin and spar)	214	119	28
Profilers, duplicators, diesinkers, engravers	1,013	306	249
Other (except thread milling)	1,319	362	285
Planers	791	242	316
Double housing	418	136	180
Openside and other	373	106	136
Pipe Cutting and Threading Machines	801	240	74
Polishing and Buffing Machines	8,267	2,937	1,074
Polishing stands (bench and floor)	3,962	1,361	414
Speed lathes	1,675	572	468
Abrasive-belt, disk, drum	1,288	498	59
Other	1,342	506	133
Shapers	3,979	1,592	1,036
Horizontal	3,464	1,332	909
Vertical, incl slotters & keyseaters	515	260	127
Threading (except pipe)	4,771	2,185	995
Tapping	1,992	873	360
Hobbing and milling	415	250	33
Die type	466	161	240
Grinders, thread	985	629	50
Rolling machines, thread	586	149	227
Other	327	123	85

	TOTAL	10-20 YEARS	OVER 20 YR
Electro-Erosion Machines (exc Tap disintegrators)	57	11	◆
Ultrasonic Cutting Machines	24	◆	◆
Special Multi-Station Machines	6,622	367	21
In-line and transfer	4,346	◆	◆
Dial or rotary table	732	113	◆
Automatic assembly (all types)	1,544	249	18
Other Metal-Cutting Machines	962	279	117
METAL-FORMING MACHINES	47,726	14,654	13,355
Bending and Forming Machines (Power)	3,695	1,141	652
Bending rolls, sheet and plate	1,085	297	285
Bending rolls, bars and shapes	251	107	40
Bending brakes	1,097	417	189
Rotary bending and forming machines	306	66	67
Bending machines, pipe, bar, and shapes	956	254	71
Wire and Strip Forming Machines	700	156	145
Hydraulic Presses	2,323	670	317
Vertical, single-action	1,755	547	203
Vertical, double and triple action	162	23	◆
Horizontal	42	◆	11
Extrusion (from hot billets)	24	◆	21
Other (incl stretch and hydro-pneumatic)	340	91	79
Pneumatic Presses (except hydro-pneumatic)	413	108	◆
Mechanical Presses (Power)	30,341	9,407	10,297
Inclinable, single-action (incl inclined)	11,999	4,209	3,360
Vertical, single-action: Straight-side (incl arch)	5,853	1,771	2,412
Vertical, single-action: Gap or C-frame	5,314	1,443	1,948
Vertical, single-action: Adjust. bed and horning	1,744	564	580
Double and triple action	574	172	144
Dieing machines	283	57	32
Horizontal (incl bulldozers)	137	44	48
Multiple transfer (incl eyeletting)	96	◆	30
Other	4,341	1,146	1,743
Punching and Shearing Machines	4,770	1,083	914
Punching machines (incl turret)	2,019	175	182
Plate and sheet shears	1,463	449	389
Bar and angle shears	422	157	111
Rotary shears, incl slitters	350	150	98
Nibbling machines	319	125	68
Other	197	27	66
Forging Machinery (except presses)	1,597	444	665
Hammers, steam or air	421	77	283
Hammers, mechanical (incl drop and helve)	163	24	99
Forging machines (headers) and rolls	784	278	236
Swaging machines	127	30	23
Other	102	35	24
Riveting Machines (not portable)	3,144	1,411	292
Squeeze type	1,610	770	125
Rotary-vibrating type	372	185	23
Spinning type	278	149	32
Hammer type	884	307	112
Die Casting Machines	455	121	60
Hot chamber	259	64	40
Cold chamber	196	57	20
Plastics Molding Machines	288	113	10
Injection	51	17	◆
Compression	233	96	10
Extrusion	◆	◆	◆
WELDING EQUIPMENT	26,699	7,212	2,488
Electric Welding Equipment	25,528	6,831	2,393
Power source: Motor-generator set	7,702	3,114	1,065
Transformer and rectifier	8,697	1,071	107
Arc-weld machines (not hand) incl automatic	2,021	543	114
Resistance welders: Spot	5,535	1,697	712
Gun (not hand)	635	108	226
Seam	228	64	42
Butt and flash	710	234	127
Gas Welding Machines (not hand)	451	108	65
Flame Cutting Machines (not hand)	720	273	30
HEATING EQUIPMENT	9,153	3,209	1,467
Heat-treating furnaces	4,298	1,929	839
Atmosphere generators	447	125	◆
Stock-heating furnaces	1,590	364	342
Salt baths	947	318	122
Induction heating units	750	148	29
Baking and drying ovens	959	299	122
Flame-hardening units	162	26	11
CLEANING AND FINISHING	8,312	2,302	1,530
Cleaning Equipment	7,460	2,012	1,426
Barrel finishing machines	2,815	705	1,082
Shot and abrasive blast	1,457	406	109
Parts washing machines (incl degreasers)	2,925	736	227
Pickling machines	263	165	◆
Plating Equipment	852	290	104
Machines	639	218	84
Barrels	213	72	20
INDUSTRIAL TRUCKS (Power-Driven)	7,822	2,008	673
Lift (rider-type)	4,383	1,122	272
Truck-tractor	926	207	36
Powered hand trucks	2,150	576	309
Crane trucks	363	103	56
OTHER SHOP EQUIPMENT	5,951	1,908	996
Balancing Machines	1,144	224	236
Air Compressors	3,437	1,283	192
Gear-Checking Machines	1,370	401	168

Indianapolis

Indiana south of a line that includes counties of Warren, Tippecanoe, Carroll, Cass, Miami, Wabash, Whitley, Noble, and Lagrange

599 plants — 227,318 employees

	Total Units	10 yr & over	Over 20 yr
METAL CUTTING	55,604	60%	16%
METAL FORMING	19,403	63	27
OTHER EQUIPMENT	19,011	47	8
TOTAL	94,018	58	17

◆ – Less than 10

	TOTAL	10-20 YEARS	OVER 20 YR
METAL-CUTTING MACHINES	55,604	24,263	9,001
Boring Machines	2,330	889	257
Horizontal boring, drilling, & milling	716	318	69
Vertical boring mills incl vert turret lathes	353	122	64
Precision, horizontal and vertical	945	362	74
Jig boring, horizontal and vertical	211	72	38
Other (except boring lathes)	105	15	12
Broaching Machines	783	322	136
Horizontal internal or combination	235	118	34
Horizontal surface	84	41	18
Vertical internal	199	52	34
Vertical surface or combination	229	109	46
Continuous horizontal & vertical	15	◆	◆
Other (incl rotary surface)	21	◆	◆
Contour Sawing and Filing	434	237	45
Cutoff Machines	2,377	1,168	280
Bandsaw (incl friction)	932	470	96
Abrasive disk	283	94	22
Hacksaws	673	361	104
Circular (incl friction)	320	151	56
Other	169	92	◆
Drilling Machines	11,542	4,927	2,384
Sensitive	3,532	1,467	854
Upright: Single-spindle	4,387	1,929	988
Gang	574	251	81
Radial	1,059	571	152
Multi-spindle cluster, adjustable and fixed center	575	247	125
Automatic	189	39	◆
Unit head & way type (not dial)	177	41	35
Deep-hole drills	105	50	13
Other (not incl special machines)	944	332	129
Gear Cutting and Finishing Machines	1,902	769	336
Hobbing machines, gear	806	265	204
Shapers, gear	414	207	60
Form-milling type (spur and bevel)	11	10	◆
Bevel-gear cutters (not planer)	102	79	◆
Grinders, gear tooth	91	41	13
Shavers, gear tooth	242	93	◆
Burnishing and lapping	60	25	25
Chamfering, tooth pointing, tooth rounding	109	45	16
Other	67	◆	◆
Grinding Machines	12,315	5,671	1,746
External cylindrical: Plain	1,209	679	192
Universal	435	207	28
Internal cylindrical	573	307	56
Centerless: External	475	209	62
Internal	65	23	◆
Surface: Rotary-table type	913	309	110
Reciprocating type	1,544	757	217
Disk, horizontal and vertical	466	258	79
Tool and cutter (incl drill)	2,502	1,168	379
Bench, floorstand, and snag	2,750	1,362	517
Jig grinders	36	14	◆
Contour grinders	114	46	22
Abrasive belt (not polishing)	376	191	◆
Other (except thread grinders)	857	141	77
Honing and Lapping	676	211	19
Honing: Internal (incl combination)	265	102	◆
External and surface	85	12	◆
Lapping: Surface	210	55	◆
Cylindrical	74	25	◆
Other (incl combination hone-lap)	42	17	◆
Lathes	10,734	5,463	1,693
Bench, floor, lt-dy (incl turret attachment)	1,342	784	137
Engine, heavy-duty: Standard	2,196	1,058	530
Toolroom	954	522	146
Manufacturing and gap	173	44	86
Tracer	94	◆	◆
Turret lathes: Ram type	1,383	918	144
Saddle type	700	467	68
Auto chucking & between centers (single spindle)	819	335	189
Automatic chucking (multi-spindle)	565	164	63
Automatic screw machines (single spindle)	1,259	573	182
Automatic bar machines (multi-spindle)	730	374	77
Other (except spinning lathes)	519	217	68
Milling Machines	4,706	2,045	807
Bench type	163	101	14
Hand	468	187	173
Knee-type: Horizontal (plain & universal)	1,358	665	324
Vertical	985	399	81
Automatic & manufacturing	418	198	61
Ram type, swivel head	90	30	◆
Bed (Lincoln) type, incl automatic rise and fall	351	159	23
Planer type (incl skin and spar)	57	15	16
Profilers, duplicators, diesinkers, engravers	475	167	68
Other (except thread milling)	341	124	46
Planers	189	90	69
Double housing	117	64	42
Openside and other	72	26	27
Pipe Cutting and Threading Machines	290	115	33
Polishing and Buffing Machines	2,528	1,088	464
Polishing stands (bench and floor)	1,226	521	212
Speed lathes	465	245	67
Abrasive-belt, disk, drum	536	199	103
Other	301	123	82
Shapers	1,119	479	275
Horizontal	930	409	216
Vertical, incl slotters & keyseaters	189	70	59
Threading (except pipe)	1,874	679	398
Tapping	1,114	446	214
Hobbing and milling	153	95	26
Die type	107	29	35
Grinders, thread	156	64	◆
Rolling machines, thread	227	44	110
Other	117	◆	◆

	TOTAL	10-20 YEARS	OVER 20 YR
Electro-Erosion Machines (exc Tap disintegrators)	14	◆	◆
Ultrasonic Cutting Machines	◆	◆	◆
Special Multi-Station Machines	1,521	65	32
In-line and transfer	1,232	◆	◆
Dial or rotary table	193	55	25
Automatic assembly (all types)	96	◆	◆
Other Metal-Cutting Machines	270	45	35
METAL-FORMING MACHINES	19,403	6,924	5,304
Bending and Forming Machines (Power)	1,908	787	271
Bending rolls, sheet and plate	613	301	88
Bending rolls, bars and shapes	71	24	13
Bending brakes	643	234	98
Rotary bending and forming machines	397	187	40
Bending machines, pipe, bar, and shapes	184	41	32
Wire and Strip Forming Machines	835	410	79
Hydraulic Presses	1,257	403	173
Vertical, single-action	878	259	136
Vertical, double and triple action	241	111	17
Horizontal	21	13	◆
Extrusion (from hot billets)	◆	◆	◆
Other (incl stretch and hydro-pneumatic)	111	18	17
Pneumatic Presses (except hydro-pneumatic)	242	140	◆
Mechanical Presses (Power)	10,789	3,859	3,888
Inclinable, single-action (incl inclined)	4,854	1,849	1,805
Vertical, single-action: Straight-side (incl arch)	1,857	704	881
Vertical, single-action: Gap or C-frame	1,405	310	719
Vertical, single-action: Adjust. bed and horning	802	250	375
Double and triple action	77	34	24
Dieing machines	89	34	25
Horizontal (incl bulldozers)	190	115	49
Multiple transfer (incl eyeletting)	243	92	77
Other	1,292	471	333
Punching and Shearing Machines	1,486	554	370
Punching machines (incl turret)	230	64	88
Plate and sheet shears	757	305	167
Bar and angle shears	151	55	37
Rotary shears, incl slitters	134	80	31
Nibbling machines	65	35	◆
Other	149	15	39
Forging Machinery (except presses)	524	101	245
Hammers, steam or air	136	43	74
Hammers, mechanical (incl drop and helve)	56	◆	52
Forging machines (headers) and rolls	271	45	98
Swaging machines	47	◆	17
Other	14	◆	◆
Riveting Machines (not portable)	1,490	477	215
Squeeze type	532	158	55
Rotary-vibrating type	248	78	42
Spinning type	61	17	12
Hammer type	657	224	106
Die Casting Machines	338	81	◆
Hot chamber	319	81	◆
Cold chamber	19	◆	◆
Plastics Molding Machines	526	112	54
Injection	199	42	◆
Compression	327	70	52
Extrusion	◆	◆	◆
WELDING EQUIPMENT	6,981	2,979	420
Electric Welding Equipment	6,815	2,929	409
Power source: Motor-generator set	1,566	674	179
Transformer and rectifier	1,417	615	20
Arc-weld machines (not hand) incl automatic	477	156	30
Resistance welders: Spot	2,691	1,166	169
Gun (not hand)	404	214	◆
Seam	107	47	◆
Butt and flash	153	57	◆
Gas Welding Machines (not hand)	33	◆	◆
Flame Cutting Machines (not hand)	133	45	◆
HEATING EQUIPMENT	5,041	2,300	517
Heat-treating furnaces	2,016	980	294
Atmosphere generators	100	18	◆
Stock-heating furnaces	658	275	115
Salt baths	1,236	671	73
Induction heating units	380	97	◆
Baking and drying ovens	585	219	26
Flame-hardening units	66	40	◆
CLEANING AND FINISHING	2,414	852	223
Cleaning Equipment	2,045	726	193
Barrel finishing machines	611	258	103
Shot and abrasive blast	477	181	32
Parts washing machines (incl degreasers)	877	249	56
Pickling machines	80	38	◆
Plating Equipment	369	126	30
Machines	320	98	22
Barrels	49	28	◆
INDUSTRIAL TRUCKS (Power-Driven)	2,731	747	69
Lift (rider-type)	1,510	407	35
Truck-tractor	229	44	◆
Powered hand trucks	836	237	27
Crane trucks	156	59	◆
OTHER SHOP EQUIPMENT	1,844	561	245
Balancing Machines	278	89	17
Air Compressors	1,090	324	157
Gear-Checking Machines	476	148	71

3887 plants — 914,018 employees

	Total Units	10 yr & over	Over 20 yr
METAL CUTTING	246,778	59%	16%
METAL FORMING	78,526	59	20
OTHER EQUIPMENT	90,957	42	6
TOTAL	416,261	55	14

• – Less than 10

Michigan (except upper peninsula) west of a line that includes counties of Emmet, Charlevoix, Antrim, Kalkaska, Missaukee, Osceola, Mecosta, Montcalm, Ionia, Eaton, Calhoun, and Branch; Indiana northwest of a line that includes counties of Benton, White, Fulton, Kosciusko, and Elkhart; Illinois north of a line that includes counties of Adams, Brown, Morgan, Sangamon, Macon, Piatt, Champaign, and Vermilion; all of the state of Iowa.

	TOTAL	10-20 YEARS	OVER 20 YR
METAL-CUTTING MACHINES	246,778	107,357	38,524
Boring Machines	8,216	3,429	1,478
Horizontal boring, drilling, & milling	2,272	1,038	583
Vertical boring mills incl vert turret lathes	2,794	1,272	642
Precision, horizontal and vertical	2,005	771	147
Jig boring, horizontal and vertical	865	300	71
Other (except boring lathes)	280	48	35
Broaching Machines	1,735	784	324
Horizontal internal or combination	743	327	191
Horizontal surface	226	77	53
Vertical internal	326	138	50
Vertical surface or combination	396	227	28
Continuous horizontal & vertical	•	•	•
Other (incl rotary surface)	37	10	•
Contour Sawing and Filing	2,446	998	131
Cutoff Machines	13,208	5,425	1,154
Bandsaw (incl friction)	5,535	2,171	400
Abrasive disk	1,640	606	94
Hacksaws	3,705	1,827	522
Circular (incl friction)	1,800	635	113
Other	448	186	25
Drilling Machines	56,366	24,111	8,762
Sensitive	6,161	2,661	1,050
Upright: Single-spindle	27,517	13,133	5,904
Gang	7,092	3,468	848
Radial	6,975	2,606	1,542
Multi-spindle cluster, adjustable and fixed center	4,082	1,559	841
Automatic	915	216	59
Unit head & way type (not dial)	684	288	56
Deep-hole drills	433	148	97
Other (not incl special machines)	2,507	1,032	365
Gear Cutting and Finishing Machines	5,775	2,386	1,625
Hobbing machines, gear	3,242	1,421	835
Shapers, gear	936	358	318
Form-milling type (spur and bevel)	253	58	101
Bevel-gear cutters (not planer)	347	169	125
Grinders, gear tooth	116	38	61
Shavers, gear tooth	332	176	29
Burnishing and lapping	184	60	49
Chamfering, tooth pointing, tooth rounding	161	47	48
Other	204	59	59
Grinding Machines	52,459	24,294	6,686
External cylindrical: Plain	4,294	2,173	882
Universal	1,507	767	165
Internal cylindrical	2,173	1,098	239
Centerless: External	2,456	1,214	141
Internal	246	140	37
Surface: Rotary-table type	2,285	1,081	323
Reciprocating type	6,421	2,771	696
Disk, horizontal and vertical	1,998	890	341
Tool and cutter (incl drill)	9,259	3,972	1,412
Bench, floorstand, and snag	14,877	7,445	2,048
Jig grinders	237	127	•
Contour grinders	587	246	40
Abrasive belt (not polishing)	4,164	1,579	177
Other (except thread grinders)	1,955	701	275
Honing and Lapping	3,342	1,363	215
Honing: Internal (incl combination)	1,781	706	98
External and surface	81	35	•
Lapping: Surface	583	250	30
Cylindrical	701	343	81
Other (incl combination hone-lap)	196	29	•
Lathes	52,033	22,548	9,092
Bench, floor, ft-dy (incl turret attachment)	8,508	3,679	1,252
Engine, heavy-duty: Standard	8,369	3,547	2,413
Toolroom	5,359	2,208	701
Manufacturing and gap	1,411	562	309
Tracer	452	69	•
Turret lathes: Ram type	6,852	3,686	1,129
Saddle type	4,136	2,132	763
Auto chucking & between centers (single spindle)	3,279	1,362	647
Automatic chucking (multi-spindle)	1,074	438	68
Automatic screw machines (single spindle)	7,840	2,916	1,222
Automatic bar machines (multi-spindle)	3,276	1,407	185
Other (except spinning lathes)	1,477	542	406
Milling Machines	24,297	10,681	4,163
Bench type	1,000	398	100
Hand	2,822	1,247	555
Knee-type: Horizontal (plain & universal)	8,363	3,828	1,758
Vertical	4,618	1,952	458
Automatic & manufacturing	1,796	982	152
Ram type, swivel head	672	241	75
Bed (Lincoln) type, incl automatic rise and fall	2,040	884	423
Planer type (incl skin and spar)	751	303	228
Profilers, duplicators, diesinkers, engravers	1,217	493	249
Other (except thread milling)	1,018	353	215
Planers	1,463	528	677
Double housing	937	323	543
Openside and other	526	205	134
Pipe Cutting and Threading Machines	1,789	633	244
Polishing and Buffing Machines	10,348	4,645	1,145
Polishing stands (bench and floor)	5,043	2,615	549
Speed lathes	1,789	691	269
Abrasive-belt, disk, drum	2,741	980	211
Other	775	359	116
Shapers	4,571	2,010	1,562
Horizontal	4,003	1,755	1,373
Vertical, incl slotters & keyseaters	568	255	189
Threading (except pipe)	6,515	3,063	951
Tapping	5,208	1,536	182
Hobbing and milling	509	243	125
Die type	821	349	156
Grinders, thread	493	356	38
Rolling machines, thread	827	283	274
Other	657	296	176

	TOTAL	10-20 YEARS	OVER 20 YR
Electro-Erosion Machines (exc Tap disintegrators)	78	11	•
Ultrasonic Cutting Machines	19	11	•
Special Multi-Station Machines	1,082	199	12
In-line and transfer	338	•	•
Dial or rotary table	360	89	•
Automatic assembly (all types)	384	107	•
Other Metal-Cutting Machines	1,036	328	303
METAL-FORMING MACHINES	78,526	30,514	15,833
Bending and Forming Machines (Power)	9,301	3,666	1,264
Bending rolls, sheet and plate	2,257	976	473
Bending rolls, bars and shapes	555	295	80
Bending brakes	4,865	1,812	562
Rotary bending and forming machines	553	164	55
Bending machines, pipe, bar, and shapes	1,071	419	94
Wire and Strip Forming Machines	5,557	1,849	1,870
Hydraulic Presses	4,621	1,665	656
Vertical, single-action	2,841	1,108	410
Vertical, double and triple action	592	234	59
Horizontal	392	95	82
Extrusion (from hot billets)	50	•	16
Other (incl stretch and hydro-pneumatic)	746	223	89
Pneumatic Presses (except hydro-pneumatic)	1,042	358	77
Mechanical Presses (Power)	37,214	14,764	8,338
Inclinable, single-action (incl inclined)	20,887	8,833	3,802
Vertical, single-action: Straight-side (incl arch)	6,498	2,116	1,960
Vertical, single-action: Gap or C-frame	5,567	2,250	1,536
Vertical, single-action: Adjust. bed and horning	1,472	519	504
Double and triple action	279	134	70
Dieing machines	253	95	40
Horizontal (incl bulldozers)	321	119	106
Multiple transfer (incl eyeletting)	417	214	43
Other	1,520	484	277
Punching and Shearing Machines	9,484	3,935	1,988
Punching machines (incl turret)	2,742	1,184	574
Plate and sheet shears	3,809	1,620	688
Bar and angle shears	791	305	248
Rotary shears, incl slitters	774	303	226
Nibbling machines	772	276	97
Other	596	247	155
Forging Machinery (except presses)	2,858	1,361	867
Hammers, steam or air	256	111	90
Hammers, mechanical (incl drop and helve)	692	347	314
Forging machines (headers) and rolls	690	332	147
Swaging machines	876	545	235
Other	344	26	81
Riveting Machines (not portable)	6,379	2,179	625
Squeeze type	2,986	1,031	294
Rotary-vibrating type	647	253	76
Spinning type	518	232	84
Hammer type	2,228	663	171
Die Casting Machines	851	290	11
Hot chamber	500	231	11
Cold chamber	351	59	•
Plastics Molding Machines	1,219	447	137
Injection	415	107	23
Compression	791	340	114
Extrusion	13	•	•
WELDING EQUIPMENT	44,618	16,420	1,948
Electric Welding Equipment	42,669	15,584	1,876
Power source: Motor-generator set	13,929	5,980	711
Power source: Transformer and rectifier	11,696	3,589	79
Arc-weld machines (not hand) incl automatic	3,151	1,132	91
Resistance welders: Spot	11,158	3,979	925
Gun (not hand)	1,232	296	•
Seam	738	306	•
Butt and flash	765	302	61
Gas Welding Machines (not hand)	430	105	•
Flame Cutting Machines (not hand)	1,519	731	68
HEATING EQUIPMENT	13,060	4,930	1,634
Heat-treating furnaces	5,799	2,314	997
Atmosphere generators	979	275	302
Stock-heating furnaces	1,507	774	85
Salt baths	812	305	75
Induction heating units	1,158	320	•
Baking and drying ovens	2,615	887	168
Flame-hardening units	190	58	•
CLEANING AND FINISHING	10,673	3,844	717
Cleaning Equipment	8,708	3,092	625
Barrel finishing machines	2,569	967	264
Shot and abrasive blast	1,656	653	161
Parts washing machines (incl degreasers)	4,328	1,429	179
Pickling machines	155	43	21
Plating Equipment	1,965	752	92
Machines	735	303	•
Barrels	1,230	449	86
INDUSTRIAL TRUCKS (Power-Driven)	12,995	3,718	413
Lift (rider-type)	8,201	2,449	313
Truck-tractor	790	295	22
Powered hand trucks	3,573	867	60
Crane trucks	431	107	18
OTHER SHOP EQUIPMENT	9,670	3,885	1,001
Balancing Machines	852	385	47
Air Compressors	7,804	3,059	778
Gear-Checking Machines	1,014	441	176

Milwaukee

Wisconsin south of a line that includes counties of Buffalo, Eau Claire, Chippewa, Taylor, Lincoln, Langlade, Oconto, and Marinette

817 plants — 259,297 employees

	Total Units	10 yr & over	Over 20 yr
METAL CUTTING	73,852	68%	21%
METAL FORMING	19,294	70	35
OTHER EQUIPMENT	26,543	45	8
TOTAL	119,689	63	21

• – Less than 10

	TOTAL	10-20 YEARS	OVER 20 YR
METAL-CUTTING MACHINES	**73,852**	**34,473**	**15,726**
Boring Machines	**3,201**	**1,525**	**748**
Horizontal boring, drilling, & milling	1,203	474	322
Vertical boring mills incl vert turret lathes	786	357	242
Precision, horizontal and vertical	748	460	87
Jig boring, horizontal and vertical	271	119	29
Other (except boring lathes)	193	115	68
Broaching Machines	**581**	**234**	**187**
Horizontal internal or combination	277	111	115
Horizontal surface	111	42	30
Vertical internal	186	51	22
Vertical surface or combination	82	28	20
Continuous horizontal & vertical	•	•	•
Other (incl rotary surface)	•	•	•
Contour Sawing and Filing	**710**	**320**	**76**
Cutoff Machines	**3,333**	**1,479**	**340**
Bandsaw (incl friction)	1,229	546	66
Abrasive disk	520	197	18
Hacksaws	1,222	640	195
Circular (incl friction)	306	89	39
Other	56	•	22
Drilling Machines	**20,678**	**9,329**	**4,698**
Sensitive	1,972	981	290
Upright: Single-spindle	10,614	4,728	2,303
Gang	2,550	1,232	689
Radial	1,993	998	482
Multi-spindle cluster, adjustable and fixed center	1,312	531	364
Automatic	435	209	•
Unit head & way type (not dial)	763	213	241
Deep-hole drills	184	89	29
Other (not incl special machines)	855	348	296
Gear Cutting and Finishing Machines	**2,665**	**1,274**	**827**
Hobbing machines, gear	1,301	561	436
Shapers, gear	518	329	128
Form-milling type (spur and bevel)	105	28	77
Bevel-gear cutters (not planer)	151	86	20
Grinders, gear tooth	35	23	•
Shavers, gear tooth	154	95	20
Burnishing and lapping	259	87	105
Chamfering, tooth pointing, tooth rounding	80	44	33
Other	62	21	•
Grinding Machines	**14,618**	**7,206**	**2,462**
External cylindrical: Plain	2,118	1,106	446
Universal	277	139	48
Internal cylindrical	404	266	51
Centerless: External	318	195	52
Internal	52	13	13
Surface: Rotary-table type	582	334	103
Reciprocating type	1,112	529	192
Disk, horizontal and vertical	686	371	93
Tool and cutter (incl drill)	2,432	1,193	436
Bench, floorstand, and snag	5,326	2,636	858
Jig grinders	28	12	•
Contour grinders	177	52	12
Abrasive belt (not polishing)	753	267	37
Other (except thread grinders)	353	93	121
Honing and Lapping	**673**	**295**	**55**
Honing: Internal (incl combination)	497	231	46
External and surface	27	•	•
Lapping: Surface	76	20	•
Cylindrical	51	26	•
Other (incl combination hone-lap)	22	11	•
Lathes	**15,029**	**7,009**	**3,378**
Bench, floor, ti-dy (incl turret attachment)	2,179	1,040	315
Engine, heavy-duty: Standard	2,400	1,178	742
Toolroom	1,634	756	309
Manufacturing and gap	640	150	334
Tracer	131	35	•
Turret lathes: Ram type	2,322	1,331	448
Saddle type	1,887	1,008	366
Auto chucking & between centers (single spindle)	1,045	335	358
Automatic chucking (multi-spindle)	535	250	133
Automatic screw machines (single spindle)	1,337	587	215
Automatic bar machines (multi-spindle)	594	268	102
Other (except spinning lathes)	305	71	56
Milling Machines	**6,028**	**3,072**	**1,377**
Bench type	198	117	17
Hand	842	393	192
Knee-type: Horizontal (plain & universal)	2,495	1,223	752
Vertical	932	466	83
Automatic & manufacturing	346	200	54
Ram type, swivel head	113	47	16
Bed (Lincoln) type, incl automatic rise and fall	366	236	76
Planer type (incl skin and spar)	170	83	65
Profilers, duplicators, diesinkers, engravers	263	124	49
Other (except thread milling)	303	183	73
Planers	**458**	**124**	**279**
Double housing	300	65	209
Openside and other	158	59	70
Pipe Cutting and Threading Machines	**637**	**172**	**80**
Polishing and Buffing Machines	**2,236**	**1,054**	**455**
Polishing stands (bench and floor)	1,005	457	258
Speed lathes	539	260	137
Abrasive-belt, disk, drum	558	275	47
Other	134	62	13
Shapers	**1,381**	**646**	**530**
Horizontal	1,102	504	446
Vertical, incl slotters & keyseaters	279	142	84
Threading (except pipe)	**1,347**	**653**	**217**
Tapping	751	348	105
Hobbing and milling	151	103	22
Die type	220	98	68
Grinders, thread	104	90	•
Rolling machines, thread	40	•	•
Other	81	20	15

	TOTAL	10-20 YEARS	OVER 20 YR
Electro-Erosion Machines (exc Tap disintegrators)	21	•	•
Ultrasonic Cutting Machines	•	•	•
Special Multi-Station Machines	**130**	**20**	•
In-line and transfer	28	•	•
Dial or rotary table	90	14	•
Automatic assembly (all types)	12	•	•
Other Metal-Cutting Machines	**126**	**61**	**17**
METAL-FORMING MACHINES	**19,294**	**6,804**	**6,786**
Bending and Forming Machines (Power)	**2,286**	**860**	**565**
Bending rolls, sheet and plate	583	249	182
Bending rolls, bars and shapes	187	87	49
Bending brakes	978	330	192
Rotary bending and forming machines	168	73	63
Bending machines, pipe, bar, and shapes	370	121	79
Wire and Strip Forming Machines	**290**	**34**	**21**
Hydraulic Presses	**1,576**	**548**	**274**
Vertical, single-action	1,013	312	183
Vertical, double and triple action	330	155	24
Horizontal	199	62	59
Extrusion (from hot billets)	•	•	•
Other (incl stretch and hydro-pneumatic)	32	19	•
Pneumatic Presses (except hydro-pneumatic)	**421**	**176**	**13**
Mechanical Presses (Power)	**9,728**	**3,288**	**4,135**
Inclinable, single-action (incl inclined)	5,168	1,715	2,082
Vertical, single-action: Straight-side (incl arch)	1,992	734	944
Vertical, single-action: Gap or C-frame	686	289	266
Vertical, single-action: Adjust. bed and horning	648	154	412
Double and triple action	528	140	254
Dieing machines	103	29	11
Horizontal (incl bulldozers)	58	•	41
Multiple transfer (incl eyeletting)	69	35	•
Other	476	185	125
Punching and Shearing Machines	**2,442**	**965**	**790**
Punching machines (incl turret)	548	131	246
Plate and sheet shears	992	424	269
Bar and angle shears	317	121	133
Rotary shears, incl slitters	274	135	102
Nibbling machines	257	127	39
Other	54	27	•
Forging Machinery (except presses)	**835**	**273**	**527**
Hammers, steam or air	306	139	153
Hammers, mechanical (incl drop and helve)	413	129	285
Forging machines (headers) and rolls	94	•	70
Swaging machines	•	•	•
Other	21	•	19
Riveting Machines (not portable)	**1,544**	**608**	**449**
Squeeze type	553	209	179
Rotary-vibrating type	165	52	45
Spinning type	156	65	29
Hammer type	670	279	196
Die Casting Machines	**92**	**38**	**12**
Hot chamber	86	38	12
Cold chamber	•	•	•
Plastics Molding Machines	**80**	**17**	•
Injection	18	•	•
Compression	62	17	•
Extrusion	•	•	•
WELDING EQUIPMENT	**13,267**	**4,731**	**640**
Electric Welding Equipment	**12,493**	**4,481**	**621**
Power source: Motor-generator set	3,496	1,694	205
Transformer and rectifier	6,092	1,449	92
Arc-weld machines (not hand) incl automatic	827	206	63
Resistance welders: Spot	1,670	835	221
Gun (not hand)	209	110	13
Seam	106	57	•
Butt and flash	93	50	20
Gas Welding Machines (not hand)	**178**	**65**	•
Flame Cutting Machines (not hand)	**596**	**265**	**15**
HEATING EQUIPMENT	**3,756**	**1,370**	**786**
Heat-treating furnaces	1,496	611	246
Atmosphere generators	179	50	•
Stock-heating furnaces	759	253	396
Salt baths	187	49	35
Induction heating units	331	179	15
Baking and drying ovens	746	217	72
Flame-hardening units	58	11	20
CLEANING AND FINISHING	**2,424**	**969**	**274**
Cleaning Equipment	**2,048**	**724**	**266**
Barrel finishing machines	647	256	94
Shot and abrasive blast	620	245	76
Parts washing machines (incl degreasers)	722	211	78
Pickling machines	59	12	18
Plating Equipment	**376**	**245**	•
Machines	95	49	•
Barrels	281	196	•
INDUSTRIAL TRUCKS (Power-Driven)	**4,052**	**1,370**	**130**
Lift (rider-type)	2,474	810	110
Truck-tractor	344	128	•
Powered hand trucks	972	336	•
Crane trucks	262	96	•
OTHER SHOP EQUIPMENT	**3,044**	**1,300**	**342**
Balancing Machines	**446**	**159**	**48**
Air Compressors	**2,145**	**957**	**230**
Gear-Checking Machines	**453**	**184**	**64**

439 plants — 88,291 employees

	Total Units	10 yr & over	Over 20 yr
METAL CUTTING	22,891	56%	14%
METAL FORMING	7761	60	25
OTHER EQUIPMENT	10,422	40	3
TOTAL	41,074	53	13

• – Less than 10

All of the state of Minnesota; Wisconsin north of a line that includes counties of Pepin, Dunn, Barron, Rusk, Price, Oneida, Forest, and Florence; the upper peninsula of Michigan

Minneapolis — St. Paul

	TOTAL	10-20 YEARS	OVER 20 YR
METAL-CUTTING MACHINES	22,891	9,605	3,224
Boring Machines	604	288	144
Horizontal boring, drilling, & milling	175	85	50
Vertical boring mills incl vert turret lathes	248	122	94
Precision, horizontal and vertical	51	22	•
Jig boring, horizontal and vertical	108	37	•
Other (except boring lathes)	22	22	•
Broaching Machines	177	76	59
Horizontal internal or combination	101	40	34
Horizontal surface	18	•	13
Vertical internal	48	25	12
Vertical surface or combination	•	•	•
Continuous horizontal & vertical	•	•	•
Other (incl rotary surface)	•	•	•
Contour Sawing and Filing	389	117	15
Cutoff Machines	1,501	542	156
Bandsaw (incl friction)	651	236	27
Abrasive disk	148	52	•
Hacksaws	533	214	101
Circular (incl friction)	137	21	25
Other	32	19	•
Drilling Machines	5,570	2,150	662
Sensitive	273	123	27
Upright: Single-spindle	3,443	1,399	408
Gang	650	233	39
Radial	642	292	105
Multi-spindle cluster, adjustable and fixed center	340	75	73
Automatic	89	12	•
Unit head & way type (not dial)	24	•	•
Deep-hole drills	•	•	•
Other (not incl special machines)	106	16	•
Gear Cutting and Finishing Machines	624	439	74
Hobbing machines, gear	243	146	34
Shapers, gear	159	124	22
Form-milling type (spur and bevel)	24	•	11
Bevel-gear cutters (not planer)	127	115	•
Grinders, gear tooth	•	•	•
Shavers, gear tooth	27	18	•
Burnishing and lapping	•	•	•
Chamfering, tooth pointing, tooth rounding	18	10	•
Other	23	23	•
Grinding Machines	4,423	2,333	381
External cylindrical: Plain	328	249	32
Universal	90	47	•
Internal cylindrical	153	114	•
Centerless: External	54	26	•
Internal	16	16	•
Surface: Rotary-table type	153	83	12
Reciprocating type	408	125	50
Disk, horizontal and vertical	120	30	25
Tool and cutter (incl drill)	757	422	78
Bench, floorstand, and snag	1,841	1,022	156
Jig grinders	14	•	•
Contour grinders	26	•	•
Abrasive belt (not polishing)	317	164	•
Other (except thread grinders)	146	27	15
Honing and Lapping	169	66	•
Honing: Internal (incl combination)	97	40	•
External and surface	15	11	•
Lapping: Surface	39	13	•
Cylindrical	18	•	•
Other (incl combination hone-lap)	•	•	•
Lathes	4,354	1,839	820
Bench, floor, ht-dy (incl turret attachment)	480	247	90
Engine, heavy-duty: Standard	1,121	469	401
Toolroom	646	201	66
Manufacturing and gap	172	16	34
Tracer	33	•	•
Turret lathes: Ram type	780	345	86
Saddle type	489	292	52
Auto chucking & between centers (single spindle)	97	21	•
Automatic chucking (multi-spindle)	120	85	14
Automatic screw machines (single spindle)	294	80	65
Automatic bar machines (multi-spindle)	78	61	•
Other (except spinning lathes)	44	14	•
Milling Machines	1,976	751	310
Bench type	54	29	16
Hand	156	85	40
Knee-type: Horizontal (plain & universal)	769	373	141
Vertical	573	121	21
Automatic & manufacturing	103	39	25
Ram type, swivel head	52	11	•
Bed (Lincoln) type, incl automatic rise and fall	40	24	•
Planer type (incl skin and spar)	41	•	34
Profilers, duplicators, diesinkers, engravers	125	34	•
Other (except thread milling)	63	30	11
Planers	207	33	155
Double housing	136	23	113
Openside and other	71	10	42
Pipe Cutting and Threading Machines	246	140	26
Polishing and Buffing Machines	1,439	352	61
Polishing stands (bench and floor)	392	140	53
Speed lathes	56	22	•
Abrasive-belt, disk, drum	484	186	•
Other	507	•	•
Shapers	491	178	209
Horizontal	403	145	176
Vertical, incl slotters & keyseaters	88	33	33
Threading (except pipe)	599	240	143
Tapping	389	159	60
Hobbing and milling	31	17	•
Die type	115	16	74
Grinders, thread	25	25	•
Rolling machines, thread	35	19	•
Other	•	•	•

	TOTAL	10-20 YEARS	OVER 20 YR
Electro-Erosion Machines (exc Tap disintegrators)	•	•	•
Ultrasonic Cutting Machines	•	•	•
Special Multi-Station Machines	43	11	•
In-line and transfer	•	•	•
Dial or rotary table	23	•	•
Automatic assembly (all types)	12	•	•
Other Metal-Cutting Machines	77	50	•
METAL-FORMING MACHINES	7,761	2,750	1,917
Bending and Forming Machines (Power)	1,508	595	357
Bending rolls, sheet and plate	422	175	121
Bending rolls, bars and shapes	120	54	34
Bending brakes	635	187	121
Rotary bending and forming machines	157	59	74
Bending machines, pipe, bar, and shapes	174	120	•
Wire and Strip Forming Machines	220	44	78
Hydraulic Presses	437	174	57
Vertical, single-action	352	152	33
Vertical, double and triple action	23	18	•
Horizontal	49	•	24
Extrusion (from hot billets)	•	•	•
Other (incl stretch and hydro-pneumatic)	13	•	•
Pneumatic Presses (except hydro-pneumatic)	76	26	•
Mechanical Presses (Power)	2,920	1,014	683
Inclinable, single-action (incl inclined)	1,876	597	281
Vertical, single-action: Straight-side (incl arch)	428	189	154
Vertical, single-action: Gap or C-frame	279	116	99
Vertical, single-action: Adjust. bed and horning	159	54	105
Double and triple action	16	•	•
Dieing machines	•	•	•
Horizontal (incl bulldozers)	62	•	31
Multiple transfer (incl eyeletting)	17	•	•
Other	81	41	•
Punching and Shearing Machines	1,606	604	455
Punching machines (incl turret)	412	193	107
Plate and sheet shears	589	163	175
Bar and angle shears	213	100	67
Rotary shears, incl slitters	185	64	54
Nibbling machines	154	81	36
Other	53	•	16
Forging Machinery (except presses)	227	65	142
Hammers, steam or air	30	14	12
Hammers, mechanical (incl drop and helve)	138	44	95
Forging machines (headers) and rolls	16	•	16
Swaging machines	43	•	19
Other	•	•	•
Riveting Machines (not portable)	680	207	142
Squeeze type	376	105	89
Rotary-vibrating type	104	18	•
Spinning type	79	50	•
Hammer type	121	34	41
Die Casting Machines	23	13	•
Hot chamber	20	13	•
Cold chamber	•	•	•
Plastics Molding Machines	64	•	•
Injection	•	•	•
Compression	59	•	•
Extrusion	•	•	•
WELDING EQUIPMENT	6,222	2,564	120
Electric Welding Equipment	5,887	2,384	110
Power source: Motor-generator set	1,632	1,009	49
Transformer and rectifier	2,342	675	•
Arc-weld machines (not hand) incl automatic	350	135	•
Resistance welders: Spot	1,390	492	30
Gun (not hand)	84	40	•
Seam	53	12	21
Butt and flash	36	21	•
Gas Welding Machines (not hand)	78	49	•
Flame Cutting Machines (not hand)	257	131	•
HEATING EQUIPMENT	1,284	426	93
Heat-treating furnaces	304	128	22
Atmosphere generators	34	11	•
Stock-heating furnaces	180	91	64
Salt baths	105	56	•
Induction heating units	80	•	•
Baking and drying ovens	567	125	•
Flame-hardening units	14	•	•
CLEANING AND FINISHING	862	220	42
Cleaning Equipment	712	162	42
Barrel finishing machines	193	43	22
Shot and abrasive blast	117	69	13
Parts washing machines (incl degreasers)	206	50	•
Pickling machines	196	•	•
Plating Equipment	150	58	•
Machines	72	31	•
Barrels	78	27	•
INDUSTRIAL TRUCKS (Power-Driven)	974	172	14
Lift (rider-type)	650	121	14
Truck-trailer	88	26	•
Powered hand trucks	166	•	•
Crane trucks	70	22	•
OTHER SHOP EQUIPMENT	1,080	440	87
Balancing Machines	89	32	•
Air Compressors	951	392	80
Gear-Checking Machines	40	16	•

St. Louis

Missouri east of a line that includes counties of Putnam, Sullivan, Linn, Chariton, Saline, Pettis, Benton, Hickory, Polk, Greene, Christian, and Stone; Illinois south of a line that includes counties of Pike, Scott, Greene, Macoupin, Montgomery, Christian, Shelby, Moultrie, Douglas, and Edgar; Kentucky west of a line that includes counties of Hardin, Hart, Barren, and Allen; Tennessee west of a line that includes counties of Henry, Benton, Decatur, and Hardin; all of the state of Arkansas.

622 plants — 185,039 employees

	Total Units	10 yr & over	Over 20 yr
METAL CUTTING	30,623	69%	16%
METAL FORMING	13,361	66	19
OTHER EQUIPMENT	14,971	48	6
TOTAL	58,955	63	14

• – Less than 10

	TOTAL	10-20 YEARS	OVER 20 YR
METAL-CUTTING MACHINES	**30,623**	**15,948**	**5,026**
Boring Machines	**1,168**	**474**	**264**
Horizontal boring, drilling, & milling	235	149	37
Vertical boring mills incl vert turret lathes	479	161	188
Precision, horizontal and vertical	192	78	•
Jig boring, horizontal and vertical	142	35	•
Other (except boring lathes)	120	51	33
Broaching Machines	**154**	**109**	**20**
Horizontal internal or combination	63	48	15
Horizontal surface	•	•	•
Vertical internal	46	20	•
Vertical surface or combination	31	27	•
Continuous horizontal & vertical	•	•	•
Other (incl rotary surface)	•	•	•
Contour Sawing and Filing	**520**	**268**	**56**
Cutoff Machines	**2,211**	**1,184**	**189**
Bandsaw (incl friction)	935	544	47
Abrasive disk	252	81	17
Hacksaws	597	344	67
Circular (incl friction)	336	172	25
Other	91	43	33
Drilling Machines	**7,566**	**3,775**	**1,196**
Sensitive	1,393	643	232
Upright: Single-spindle	4,220	2,216	632
Gang	597	288	147
Radial	609	355	105
Multi-spindle cluster, adjustable and fixed center	325	108	67
Automatic	109	30	•
Unit head & way type (not dial)	100	•	•
Deep-hole drills	14	•	•
Other (not incl special machines)	199	126	13
Gear Cutting and Finishing Machines	**377**	**225**	**77**
Hobbing machines, gear	90	44	25
Shapers, gear	201	157	18
Form-milling type (spur and bevel)	24	•	20
Bevel-gear cutters (not planer)	28	15	•
Grinders, gear tooth	•	•	•
Shavers, gear tooth	16	•	•
Burnishing and lapping	•	•	•
Chamfering, tooth pointing, tooth rounding	•	•	•
Other	•	•	•
Grinding Machines	**6,108**	**3,239**	**778**
External cylindrical: Plain	344	201	29
Universal	206	106	11
Internal cylindrical	159	111	13
Centerless: External	130	91	•
Internal	•	•	•
Surface: Rotary-table type	272	162	37
Reciprocating type	674	300	100
Disk, horizontal and vertical	569	300	191
Tool and cutter (incl drill)	1,015	492	116
Bench, floorstand, and snag	2,050	1,130	259
Jig grinders	14	•	•
Contour grinders	73	32	•
Abrasive belt (not polishing)	478	238	•
Other (except thread grinders)	115	59	18
Honing and Lapping	**517**	**262**	**69**
Honing: Internal (incl combination)	281	110	24
External and surface	37	13	•
Lapping: Surface	136	117	18
Cylindrical	32	•	27
Other (incl combination hone-lap)	31	17	•
Lathes	**5,980**	**3,253**	**1,296**
Bench, floor, lt-dy (incl turret attachment)	1,008	616	169
Engine, heavy-duty: Standard	1,750	824	584
Toolroom	916	469	131
Manufacturing and gap	129	51	71
Tracer	68	21	•
Turret lathes: Ram type	636	392	70
Saddle type	320	180	84
Auto chucking & between centers (single spindle)	122	86	•
Automatic chucking (multi-spindle)	93	73	•
Automatic screw machines (single spindle)	456	243	84
Automatic bar machines (multi-spindle)	369	248	76
Other (except spinning lathes)	113	50	20
Milling Machines	**2,828**	**1,652**	**447**
Bench type	81	60	•
Hand	422	285	91
Knee-type: Horizontal (plain & universal)	1,060	606	203
Vertical	564	347	43
Automatic & manufacturing	256	122	95
Ram type, swivel head	55	28	•
Bed (Lincoln) type, incl automatic rise and fall	99	47	•
Planer type (incl skin and spar)	46	19	•
Profilers, duplicators, diesinkers, engravers	128	62	•
Other (except thread milling)	117	76	•
Planers	**302**	**184**	**106**
Double housing	224	149	70
Openside and other	78	35	36
Pipe Cutting and Threading Machines	**371**	**176**	**49**
Polishing and Buffing Machines	**943**	**413**	**153**
Polishing stands (bench and floor)	494	189	85
Speed lathes	70	33	23
Abrasive-belt, disk, drum	327	173	41
Other	52	18	•
Shapers	**745**	**390**	**224**
Horizontal	640	330	203
Vertical, incl slotters & keyseaters	105	60	21
Threading (except pipe)	**467**	**238**	**65**
Tapping	302	170	30
Hobbing and milling	35	15	19
Die type	54	27	•
Grinders, thread	27	13	•
Rolling machines, thread	41	13	•
Other	•	•	•

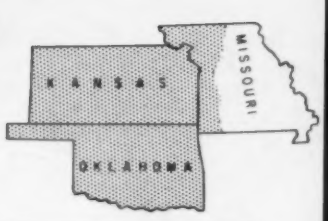
	TOTAL	10-20 YEARS	OVER 20 YR
Electro-Erosion Machines (exc Tap disintegrators)	33	•	•
Ultrasonic Cutting Machines	•	•	•
Special Multi-Station Machines	**323**	**99**	**36**
In-line and transfer	•	•	•
Dial or rotary table	171	41	36
Automatic assembly (all types)	148	55	•
Other Metal-Cutting Machines	•	•	•
METAL-FORMING MACHINES	**13,361**	**6,321**	**2,471**
Bending and Forming Machines (Power)	**2,128**	**916**	**313**
Bending rolls, sheet and plate	393	174	68
Bending rolls, bars and shapes	112	55	18
Bending brakes	1,091	485	160
Rotary bending and forming machines	163	75	•
Bending machines, pipe, bar, and shapes	369	127	64
Wire and Strip Forming Machines	**437**	**146**	**123**
Hydraulic Presses	**1,083**	**302**	**58**
Vertical, single-action	955	263	39
Vertical, double and triple action	74	19	•
Horizontal	38	15	19
Extrusion (from hot billets)	•	•	•
Other (incl stretch and hydro-pneumatic)	16	•	•
Pneumatic Presses (except hydro-pneumatic)	**384**	**217**	**23**
Mechanical Presses (Power)	**5,554**	**2,921**	**1,220**
Inclinable, single-action (incl inclined)	3,364	1,758	702
Vertical, single-action: Straight-side (incl arch)	859	550	140
Vertical, single-action: Gap or C-frame	667	355	230
Vertical, single-action: Adjust, bed and horning	250	121	39
Double and triple action	36	•	23
Dieing machines	36	16	•
Horizontal (incl bulldozers)	55	25	30
Multiple transfer (incl eyeletting)	18	•	•
Other	269	88	156
Punching and Shearing Machines	**2,057**	**1,143**	**413**
Punching machines (incl turret)	508	361	95
Plate and sheet shears	735	381	112
Bar and angle shears	316	144	124
Rotary shears, incl slitters	218	104	60
Nibbling machines	162	82	20
Other	118	71	•
Forging Machinery (except presses)	**277**	**148**	**110**
Hammers, steam or air	24	19	•
Hammers, mechanical (incl drop and helve)	130	90	32
Forging machines (headers) and rolls	71	18	52
Swaging machines	28	10	13
Other	24	•	13
Riveting Machines (not portable)	**1,206**	**494**	**198**
Squeeze type	539	244	37
Rotary-vibrating type	104	30	39
Spinning type	199	122	10
Hammer type	364	98	112
Die Casting Machines	**135**	**•**	**10**
Hot chamber	104	•	10
Cold chamber	31	•	•
Plastics Molding Machines	**100**	**34**	**•**
Injection	83	24	•
Compression	17	10	•
Extrusion	•	•	•
WELDING EQUIPMENT	**7,096**	**3,466**	**253**
Electric Welding Equipment	**6,691**	**3,267**	**248**
Power source: Motor-generator set	2,545	1,451	72
Transformer and rectifier	1,597	515	13
Arc-weld machines (not hand) incl automatic	300	146	•
Resistance welders: Spot	1,707	804	95
Gun (not hand)	150	92	•
Seam	117	96	•
Butt and flash	275	163	51
Gas Welding Machines (not hand)	**105**	**63**	**•**
Flame Cutting Machines (not hand)	**300**	**136**	**•**
HEATING EQUIPMENT	**1,863**	**809**	**194**
Heat-treating furnaces	631	312	106
Atmosphere generators	30	•	•
Stock-heating furnaces	167	101	11
Salt baths	206	100	10
Induction heating units	252	82	•
Baking and drying ovens	556	200	67
Flame-hardening units	21	•	•
CLEANING AND FINISHING	**2,117**	**473**	**104**
Cleaning Equipment	**915**	**316**	**84**
Barrel finishing machines	253	68	32
Shot and abrasive blast	235	65	13
Parts washing machines (incl degreasers)	414	178	15
Pickling machines	13	•	•
Plating Equipment	**1,202**	**159**	**20**
Machines	854	67	•
Barrels	348	92	20
INDUSTRIAL TRUCKS (Power-Driven)	**2,335**	**824**	**111**
Lift (rider-type)	1,279	449	56
Truck-tractor	235	49	•
Powered hand trucks	731	307	35
Crane trucks	90	19	20
OTHER SHOP EQUIPMENT	**1,560**	**816**	**194**
Balancing Machines	**176**	**71**	**•**
Air Compressors	**1,345**	**722**	**188**
Gear-Checking Machines	**39**	**23**	**•**

535 plants — 136,107 employees

	Total Units	10 yr & over	Over 20 yr
METAL CUTTING	19,211	58%	11%
METAL FORMING	8214	66	17
OTHER EQUIPMENT	11,985	46	4
TOTAL	39,410	56	10

◆ — Less than 10

Kansas City — Tulsa



All of the states of Kansas and Oklahoma; Missouri west of a line that includes counties of Mercer, Grundy, Livingston, Carroll, Lafayette, Johnson, Henry, St. Clair, Cedar, Dade, Lawrence, and Barry

	TOTAL	10-20 YEARS	OVER 20 YR
METAL-CUTTING MACHINES	19,211	8,957	2,153
Boring Machines	636	248	173
Horizontal boring, drilling, & milling	241	79	80
Vertical boring mills incl vert turret lathes	239	106	85
Precision, horizontal and vertical	64	38	◆
Jig boring, horizontal and vertical	90	24	◆
Other (except boring lathes)	◆	◆	◆
Broaching Machines	97	37	23
Horizontal internal or combination	45	21	◆
Horizontal surface	33	13	13
Vertical internal	14	◆	◆
Vertical surface or combination	◆	◆	◆
Continuous horizontal & vertical	◆	◆	◆
Other (incl rotary surface)	◆	◆	◆
Contour Sawing and Filing	223	96	◆
Cutoff Machines	1,808	784	112
Bandsaw (incl friction)	924	327	39
Abrasive disk	161	60	◆
Hacksaws	434	204	46
Circular (incl friction)	249	105	24
Other	40	◆	◆
Drilling Machines	3,788	1,577	490
Sensitive	598	232	32
Upright: Single-spindle	2,077	801	264
Gang	219	106	34
Radial	466	218	106
Multi-spindle cluster, adjustable and fixed center	110	65	16
Automatic	27	◆	◆
Unit head & way type (not dial)	94	56	34
Deep-hole drills	21	◆	◆
Other (not incl special machines)	176	92	◆
Gear Cutting and Finishing Machines	230	124	52
Hobbing machines, gear	106	62	32
Shapers, gear	48	41	◆
Form-milling type (spur and bevel)	13	◆	13
Bevel-gear cutters (not planer)	36	◆	◆
Grinders, gear tooth	◆	◆	◆
Shavers, gear tooth	◆	◆	◆
Burnishing and lapping	11	10	◆
Chamfering, tooth pointing, tooth rounding	◆	◆	◆
Other	◆	◆	◆
Grinding Machines	4,157	2,092	307
External cylindrical: Plain	140	84	20
Universal	92	65	◆
Internal cylindrical	96	77	◆
Centerless: External	69	52	◆
Internal	◆	◆	◆
Surface: Rotary-table type	181	49	27
Reciprocating type	300	156	30
Disk, horizontal and vertical	181	110	10
Tool and cutter (incl drill)	912	508	70
Bench, floorstand, and snag	1,519	761	124
Jig grinders	144	◆	16
Contour grinders	49	24	◆
Abrasive belt (not polishing)	294	125	◆
Other (except thread grinders)	171	77	◆
Honing and Lapping	155	50	10
Honing: Internal (incl combination)	99	30	◆
External and surface	◆	◆	◆
Lapping: Surface	17	◆	◆
Cylindrical	10	◆	◆
Other (incl combination hone-lap)	21	16	◆
Lathes	4,089	2,305	539
Bench, floor, ft-dy (incl turret attachment)	516	265	95
Engine, heavy-duty: Standard	999	377	267
Toolroom	510	192	42
Manufacturing and gap	144	86	47
Tracer	32	10	◆
Turret lathes: Ram type	528	357	16
Saddle type	345	240	41
Auto chucking & between centers (single spindle)	603	539	10
Automatic chucking (multi-spindle)	44	28	◆
Automatic screw machines (single spindle)	194	103	◆
Automatic bar machines (multi-spindle)	113	79	◆
Other (except spinning lathes)	61	29	◆
Milling Machines	1,834	723	105
Bench type	69	47	◆
Hand	98	45	11
Knee-type: Horizontal (plain & universal)	700	334	48
Vertical	563	128	14
Automatic & manufacturing	45	35	◆
Ram type, swivel head	36	◆	◆
Bed (Lincoln) type, incl automatic rise and fall	99	39	◆
Planer type (incl skin and spar)	58	◆	16
Profilers, duplicators, diesinkers, engravers	117	60	◆
Other (except thread milling)	49	22	◆
Planers	147	18	99
Double housing	98	◆	66
Openside and other	49	◆	33
Pipe Cutting and Threading Machines	228	107	◆
Polishing and Buffing Machines	589	232	25
Polishing stands (bench and floor)	128	73	◆
Speed lathes	150	59	◆
Abrasive-belt, disk, drum	306	95	17
Other	◆	◆	◆
Shapers	455	233	134
Horizontal	341	168	95
Vertical, incl slotters & keyseaters	114	65	29
Threading (except pipe)	426	211	87
Tapping	177	102	10
Hobbing and milling	21	14	◆
Die type	148	56	56
Grinders, thread	32	23	◆
Rolling machines, thread	◆	◆	◆
Other	44	12	16

	TOTAL	10-20 YEARS	OVER 20 YR
Electro-Erosion Machines (exc Tap disintegrators)	◆	◆	◆
Ultrasonic Cutting Machines	◆	◆	◆
Special Multi-Station Machines	306	177	◆
In-line and transfer	◆	◆	◆
Dial or rotary table	15	12	◆
Automatic assembly (all types)	291	165	◆
Other Metal-Cutting Machines	34	20	◆
METAL-FORMING MACHINES	8,214	4,045	1,361
Bending and Forming Machines (Power)	1,841	973	279
Bending rolls, sheet and plate	518	281	109
Bending rolls, bars and shapes	187	84	64
Bending brakes	927	518	86
Rotary bending and forming machines	32	◆	◆
Bending machines, pipe, bar, and shapes	177	87	12
Wire and Strip Forming Machines	357	184	◆
Hydraulic Presses	838	241	132
Vertical, single-action	733	208	117
Vertical, double and triple action	20	◆	◆
Horizontal	54	17	14
Extrusion (from hot billets)	◆	◆	◆
Other (incl stretch and hydro-pneumatic)	30	14	◆
Pneumatic Presses (except hydro-pneumatic)	239	129	◆
Mechanical Presses (Power)	2,171	1,159	336
Inclinable, single-action (incl inclined)	858	382	136
Vertical, single-action: Straight-side (incl arch)	395	266	25
Vertical, single-action: Gap or C-frame	492	242	154
Vertical, single-action: Adjust. bed and horning	25	11	◆
Double and triple action	101	85	◆
Dieing machines	67	26	◆
Horizontal (incl bulldozers)	143	86	21
Multiple transfer (incl eyeletting)	67	55	◆
Other	23	◆	◆
Punching and Shearing Machines	1,768	878	403
Punching machines (incl turret)	609	280	202
Plate and sheet shears	621	353	97
Bar and angle shears	208	59	60
Rotary shears, incl slitters	169	106	40
Nibbling machines	150	76	◆
Other	11	◆	◆
Forging Machinery (except presses)	186	118	57
Hammers, steam or air	62	25	29
Hammers, mechanical (incl drop and helve)	43	21	20
Forging machines (headers) and rolls	16	◆	◆
Swaging machines	65	64	◆
Other	◆	◆	◆
Riveting Machines (not portable)	717	304	146
Squeeze type	551	235	100
Rotary-vibrating type	38	16	12
Spinning type	26	22	◆
Hammer type	102	31	34
Die Casting Machines	◆	◆	◆
Hot chamber	◆	◆	◆
Cold chamber	◆	◆	◆
Plastics Molding Machines	94	59	◆
Injection	◆	◆	◆
Compression	88	54	◆
Extrusion	◆	◆	◆
WELDING EQUIPMENT	7,647	3,311	262
Electric Welding Equipment	7,088	2,981	247
Power source: Motor-generator set	2,231	1,443	65
Transformer and rectifier	2,786	806	78
Arc-weld machines (not hand) incl automatic	443	115	◆
Resistance welders: Spot	1,385	514	84
Gun (not hand)	41	◆	◆
Seam	157	90	◆
Butt and flash	45	12	◆
Gas Welding Machines (not hand)	45	22	◆
Flame Cutting Machines (not hand)	514	308	11
HEATING EQUIPMENT	1,112	533	53
Heat-treating furnaces	370	224	35
Atmosphere generators	27	◆	◆
Stock-heating furnaces	73	49	◆
Salt baths	84	69	◆
Induction heating units	193	24	◆
Baking and drying ovens	335	146	◆
Flame-hardening units	30	18	◆
CLEANING AND FINISHING	811	458	43
Cleaning Equipment	736	431	43
Barrel finishing machines	284	168	34
Shot and abrasive blast	108	61	◆
Parts washing machines (incl degreasers)	322	197	◆
Pickling machines	22	◆	◆
Plating Equipment	75	27	◆
Machines	42	◆	◆
Barrels	33	19	◆
INDUSTRIAL TRUCKS (Power-Driven)	1,391	371	16
Lift (rider-type)	858	275	◆
Truck-tractor	243	37	◆
Powered hand trucks	200	44	◆
Crane trucks	90	15	16
OTHER SHOP EQUIPMENT	1,024	369	98
Balancing Machines	71	25	◆
Air Compressors	945	343	98
Gear-Checking Machines	◆	◆	◆

Dallas — Houston

All of the states of Texas and New Mexico

801 plants — 159,066 employees

	Total Units	10 yr & over	Over 20 yr
METAL CUTTING	28,036	43%	9%
METAL FORMING	10,051	49	13
OTHER EQUIPMENT	18,779	33	4
TOTAL	56,866	41	8

◆ — Less than 10

	TOTAL	10-20 YEARS	OVER 20 YR
METAL-CUTTING MACHINES	28,036	9,542	2,635
Boring Machines	972	413	185
Horizontal boring, drilling, & milling	197	95	40
Vertical boring mills incl vert turret lathes	458	223	139
Precision, horizontal and vertical	123	40	◆
Jig boring, horizontal and vertical	194	55	◆
Other (except boring lathes)	◆	◆	◆
Broaching Machines	58	30	◆
Horizontal internal or combination	14	◆	◆
Horizontal surface	16	◆	◆
Vertical internal	14	12	◆
Vertical surface or combination	14	◆	◆
Continuous horizontal & vertical	◆	◆	◆
Other (incl rotary surface)	◆	◆	◆
Contour Sawing and Filing	388	143	◆
Cutoff Machines	2,666	693	85
Bandsaw (incl friction)	1,105	317	33
Abrasive disk	381	57	11
Hacksaws	684	242	39
Circular (incl friction)	342	69	◆
Other	154	◆	◆
Drilling Machines	5,400	1,835	436
Sensitive	496	165	10
Upright: Single-spindle	3,419	1,070	283
Gang	231	75	10
Radial	742	292	119
Multi-spindle cluster, adjustable and fixed center	226	118	◆
Automatic	83	26	◆
Unit head & way type (not dial)	11	◆	◆
Deep-hole drills	21	◆	◆
Other (not incl special machines)	171	89	◆
Gear Cutting and Finishing Machines	195	58	35
Hobbing machines, gear	53	26	12
Shapers, gear	51	◆	23
Form-milling type (spur and bevel)	29	13	◆
Bevel-gear cutters (not planer)	20	◆	◆
Grinders, gear tooth	39	10	◆
Shavers, gear tooth	◆	◆	◆
Burnishing and lapping	◆	◆	◆
Chamfering, tooth pointing, tooth rounding	◆	◆	◆
Other	◆	◆	◆
Grinding Machines	6,482	2,141	711
External cylindrical: Plain	362	86	26
Universal	189	61	10
Internal cylindrical	305	119	23
Centerless: External	96	28	13
Internal	◆	◆	◆
Surface: Rotary-table type	238	39	31
Reciprocating type	403	181	35
Disk, horizontal and vertical	249	61	15
Tool and cutter (incl drill)	1,247	532	72
Bench, floorstand, and snag	2,274	733	464
Jig grinders	56	◆	◆
Contour grinders	55	20	◆
Abrasive belt (not polishing)	656	110	11
Other (except thread grinders)	345	164	◆
Honing and Lapping	235	90	◆
Honing: Internal (incl combination)	175	78	◆
External and surface	12	◆	◆
Lapping: Surface	42	◆	◆
Cylindrical	◆	◆	◆
Other (incl combination hone-lap)	◆	◆	◆
Lathes	5,915	2,186	535
Bench, floor, ft-dy (incl turret attachment)	750	306	36
Engine, heavy-duty: Standard	1,605	605	260
Toolroom	664	205	78
Manufacturing and gap	164	68	◆
Tracer	101	◆	◆
Turret lathes: Ram type	1,009	423	34
Saddle type	919	320	101
Auto chucking & between centers (single spindle)	181	40	◆
Automatic chucking (multi-spindle)	177	77	10
Automatic screw machines (single spindle)	119	44	◆
Automatic bar machines (multi-spindle)	131	39	◆
Other (except spinning lathes)	95	57	◆
Milling Machines	2,739	859	269
Bench type	139	26	◆
Hand	223	90	◆
Knee-type: Horizontal (plain & universal)	1,219	394	162
Vertical	591	189	41
Automatic & manufacturing	68	37	◆
Ram type, swivel head	113	20	◆
Bed (Lincoln) type, incl automatic rise and fall	61	15	◆
Planer type (incl skin and spar)	62	19	◆
Profilers, duplicators, diesinkers, engravers	159	41	◆
Other (except thread milling)	104	28	30
Planers	188	41	108
Double housing	123	37	64
Openside and other	65	◆	44
Pipe Cutting and Threading Machines	461	170	25
Polishing and Buffing Machines	979	328	48
Polishing stands (bench and floor)	471	123	30
Speed lathes	93	45	◆
Abrasive-belt, disk, drum	399	158	16
Other	16	◆	◆
Shapers	551	253	131
Horizontal	452	207	91
Vertical, incl slotters & keyseaters	99	46	40
Threading (except pipe)	654	279	51
Tapping	225	108	◆
Hobbing and milling	86	52	◆
Die type	182	82	34
Grinders, thread	67	37	◆
Rolling machines, thread	34	◆	◆
Other	60	◆	◆

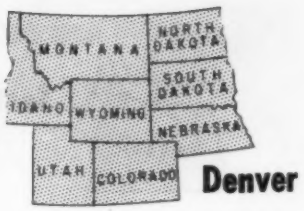
	TOTAL	10-20 YEARS	OVER 20 YR
Electro-Erosion Machines (exc Tap disintegrators)	◆	◆	◆
Ultrasonic Cutting Machines	◆	◆	◆
Special Multi-Station Machines	58	◆	◆
In-line and transfer	◆	◆	◆
Dial or rotary table	15	◆	◆
Automatic assembly (all types)	40	◆	◆
Other Metal-Cutting Machines	81	21	◆
METAL-FORMING MACHINES	10,051	3,616	1,313
Bending and Forming Machines (Power)	2,519	900	226
Bending rolls, sheet and plate	760	313	129
Bending rolls, bars and shapes	124	62	◆
Bending brakes	1,131	390	69
Rotary bending and forming machines	226	38	◆
Bending machines, pipe, bar, and shapes	278	97	20
Wire and Strip Forming Machines	140	49	19
Hydraulic Presses	574	206	77
Vertical, single-action	399	166	39
Vertical, double and triple action	78	18	◆
Horizontal	74	19	35
Extrusion (from hot billets)	◆	◆	◆
Other (incl stretch and hydro-pneumatic)	22	◆	◆
Pneumatic Presses (except hydro-pneumatic)	75	37	10
Mechanical Presses (Power)	2,824	1,107	417
Inclinable, single-action (incl inclined)	1,839	864	133
Vertical, single-action: Straight-side (incl arch)	399	129	63
Vertical, single-action: Gap or C-frame	290	42	98
Vertical, single-action: Adjust. bed and horning	31	◆	19
Double and triple action	18	◆	◆
Dieing machines	13	◆	◆
Horizontal (incl bulldozers)	69	◆	24
Multiple transfer (incl eyeletting)	◆	◆	◆
Other	158	47	69
Punching and Shearing Machines	2,536	924	285
Punching machines (incl turret)	863	330	143
Plate and sheet shears	894	291	74
Bar and angle shears	355	139	52
Rotary shears, incl slitters	142	69	◆
Nibbling machines	241	67	◆
Other	41	28	◆
Forging Machinery (except presses)	462	107	232
Hammers, steam or air	97	18	32
Hammers, mechanical (incl drop and helve)	210	57	137
Forging machines (headers) and rolls	79	20	47
Swaging machines	58	10	◆
Other	18	◆	◆
Riveting Machines (not portable)	895	282	47
Squeeze type	442	100	19
Rotary-vibrating type	75	17	17
Spinning type	18	◆	◆
Hammer type	360	158	11
Die Casting Machines	◆	◆	◆
Hot chamber	◆	◆	◆
Cold chamber	◆	◆	◆
Plastics Molding Machines	19	◆	◆
Injection	◆	◆	◆
Compression	◆	◆	◆
Extrusion	11	◆	◆
WELDING EQUIPMENT	11,013	3,632	309
Electric Welding Equipment	10,214	3,409	263
Power source: Motor-generator set	3,696	1,921	117
Transformer and rectifier	3,820	964	30
Arc-weld machines (not hand) incl automatic	1,117	149	65
Resistance welders: Spot	1,284	297	23
Gun (not hand)	143	13	◆
Seam	36	◆	◆
Butt and flash	118	57	28
Gas Welding Machines (not hand)	151	71	◆
Flame Cutting Machines (not hand)	648	150	46
HEATING EQUIPMENT	1,786	488	287
Heat-treating furnaces	795	264	124
Atmosphere generators	122	24	◆
Stock-heating furnaces	203	65	108
Salt baths	97	18	◆
Induction heating units	137	29	◆
Baking and drying ovens	409	77	43
Flame-hardening units	23	11	◆
CLEANING AND FINISHING	1,311	268	101
Cleaning Equipment	1,047	228	84
Barrel finishing machines	411	78	49
Shot and abrasive blast	307	69	20
Parts washing machines (incl degreasers)	311	77	15
Pickling machines	18	◆	◆
Plating Equipment	264	40	17
Machines	152	23	◆
Barrels	112	17	17
INDUSTRIAL TRUCKS (Power-Driven)	2,824	448	14
Lift (rider-type)	1,376	287	◆
Truck-tractor	927	73	◆
Powered hand trucks	285	28	◆
Crane trucks	236	60	◆
OTHER SHOP EQUIPMENT	1,845	523	75
Balancing Machines	86	19	◆
Air Compressors	1,719	502	75
Gear-Checking Machines	40	◆	◆

294 plants — 43,269 employees

	Total Units	10 yr & over	Over 20 yr
METAL CUTTING	17,050	62%	9%
METAL FORMING	3573	69	19
OTHER EQUIPMENT	7298	56	7
TOTAL	27,921	61	10

• – Less than 10

All of the states of Colorado, North Dakota, South Dakota, Nebraska, Montana, Wyoming, Idaho, and Utah



	TOTAL	10-20 YEARS	OVER 20 YR
METAL-CUTTING MACHINES	17,050	9,008	1,577
Boring Machines	850	324	72
Horizontal boring, drilling, & milling	314	133	17
Vertical boring mills incl vert turret lathes	290	102	55
Precision, horizontal and vertical	153	51	•
Jig boring, horizontal and vertical	74	38	•
Other (except boring lathes)	19	•	•
Broaching Machines	68	20	•
Horizontal internal or combination	40	14	•
Horizontal surface	•	•	•
Vertical internal	19	•	•
Vertical surface or combination	•	•	•
Continuous horizontal & vertical	•	•	•
Other (incl rotary surface)	•	•	•
Contour Sawing and Filing	219	103	•
Cutoff Machines	1,016	547	47
Bandsaw (incl friction)	385	193	23
Abrasive disk	180	96	•
Hacksaws	341	213	14
Circular (incl friction)	101	45	10
Other	•	•	•
Drilling Machines	3,413	1,703	266
Sensitive	908	490	44
Upright: Single-spindle	1,449	713	123
Gang	300	132	15
Radial	382	215	23
Multi-spindle cluster, adjustable and fixed center	205	97	•
Automatic	41	•	•
Unit head & way type (not dial)	19	•	•
Deep-hole drills	27	16	•
Other (not incl special machines)	82	28	54
Gear Cutting and Finishing Machines	354	201	48
Hobbing machines, gear	136	78	17
Shapers, gear	114	89	•
Form-milling type (spur and bevel)	19	•	19
Bevel-gear cutters (not planer)	33	25	•
Grinders, gear tooth	15	•	•
Shavers, gear tooth	12	•	•
Burnishing and lapping	15	•	•
Chamfering, tooth pointing, tooth rounding	•	•	•
Other	•	•	•
Grinding Machines	3,511	1,829	445
External cylindrical: Plain	289	189	12
Universal	166	85	•
Internal cylindrical	170	78	28
Centerless: External	66	33	•
Internal	•	•	•
Surface: Rotary-table type	93	45	10
Reciprocating type	248	145	•
Disk, horizontal and vertical	97	46	10
Tool and cutter (incl drill)	647	381	32
Bench, floorstand, and snag	1,382	648	318
Jig grinders	13	•	•
Contour grinders	18	•	•
Abrasive belt (not polishing)	181	84	•
Other (except thread grinders)	136	85	15
Honing and Lapping	220	83	10
Honing: Internal (incl combination)	129	63	•
External and surface	•	•	•
Lapping: Surface	63	15	10
Cylindrical	17	•	•
Other (incl combination hone-lap)	15	•	•
Lathes	3,710	2,128	328
Bench, floor, lt-dy (incl turret attachment)	691	421	62
Engine, heavy-duty: Standard	996	536	187
Toolroom	470	226	•
Manufacturing and gap	25	•	20
Tracer	25	•	•
Turret lathes: Ram type	595	405	•
Saddle type	385	262	29
Auto chucking & between centers (single spindle)	51	29	•
Automatic chucking (multi-spindle)	35	11	•
Automatic screw machines (single spindle)	343	183	•
Automatic bar machines (multi-spindle)	71	43	•
Other (except spinning lathes)	23	10	•
Milling Machines	1,548	890	78
Bench type	103	66	•
Hand	113	70	•
Knee-type: Horizontal (plain & universal)	617	369	33
Vertical	294	158	22
Automatic & manufacturing	69	46	•
Ram type, swivel head	72	33	•
Bed (Lincoln) type, incl automatic rise and fall	87	51	•
Planer type (incl skin and spar)	44	27	•
Profilers, duplicators, diesinkers, engravers	99	43	•
Other (except thread milling)	50	27	•
Planers	143	62	81
Double housing	92	29	62
Openside and other	51	33	19
Pipe Cutting and Threading Machines	330	121	54
Polishing and Buffing Machines	819	594	•
Polishing stands (bench and floor)	249	185	•
Speed lathes	253	156	•
Abrasive-belt, disk, drum	245	185	•
Other	72	68	•
Shapers	421	186	96
Horizontal	324	154	82
Vertical, incl slotters & keyseaters	77	32	14
Threading (except pipe)	379	284	32
Tapping	130	58	•
Hobbing and milling	79	44	•
Die type	110	65	16
Grinders, thread	31	30	•
Rolling machines, thread	10	•	•
Other	19	•	11

	TOTAL	10-20 YEARS	OVER 20 YR
Electro-Erosion Machines (exc Tap disintegrators)	•	•	•
Ultrasonic Cutting Machines	•	•	•
Special Multi-Station Machines	17	•	•
In-line and transfer	•	•	•
Dial or rotary table	•	•	•
Automatic assembly (all types)	•	•	•
Other Metal-Cutting Machines	33	13	•
METAL-FORMING MACHINES	3,573	1,790	687
Bending and Forming Machines (Power)	806	324	154
Bending rolls, sheet and plate	241	105	68
Bending rolls, bars and shapes	58	20	18
Bending brakes	328	114	42
Rotary bending and forming machines	53	31	10
Bending machines, pipe, bar, and shapes	126	54	16
Wire and Strip Forming Machines	34	32	•
Hydraulic Presses	435	233	53
Vertical, single-action	295	168	30
Vertical, double and triple action	50	28	•
Horizontal	34	•	13
Extrusion (from hot billets)	•	•	•
Other (incl stretch and hydro-pneumatic)	56	30	10
Pneumatic Presses (except hydro-pneumatic)	35	•	•
Mechanical Presses (Power)	900	530	110
Inclinable, single-action (incl inclined)	357	211	75
Vertical, single-action: Straight-side (incl arch)	78	61	17
Vertical, single-action: Gap or C-frame	401	230	10
Vertical, single-action: Adjust. bed and horning	11	•	•
Double and triple action	•	•	•
Dieing machines	21	•	•
Horizontal (incl bulldozers)	15	•	•
Multiple transfer (incl eyeletting)	•	•	•
Other	10	•	•
Punching and Shearing Machines	959	509	270
Punching machines (incl turret)	344	175	125
Plate and sheet shears	289	158	59
Bar and angle shears	105	47	36
Rotary shears, incl slitters	112	71	25
Nibbling machines	51	28	•
Other	58	30	21
Forging Machinery (except presses)	114	45	57
Hammers, steam or air	45	19	26
Hammers, mechanical (incl drop and helve)	27	•	18
Forging machines (headers) and rolls	15	•	•
Swaging machines	19	12	•
Other	•	•	•
Riveting Machines (not portable)	255	110	30
Squeeze type	89	36	•
Rotary-vibrating type	•	•	•
Spinning type	22	14	•
Hammer type	137	56	30
Die Casting Machines	16	10	•
Hot chamber	16	10	•
Cold chamber	•	•	•
Plastics Molding Machines	19	•	•
Injection	•	•	•
Compression	10	•	•
Extrusion	•	•	•
WELDING EQUIPMENT	3,883	2,009	173
Electric Welding Equipment	3,611	1,860	151
Power source: Motor-generator set	1,518	483	90
Transformer and rectifier	882	451	26
Arc-weld machines (not hand) incl automatic	888	741	26
Resistance welders: Spot	265	149	•
Gun (not hand)	15	•	•
Seam	12	•	•
Butt and flash	31	23	•
Gas Welding Machines (not hand)	53	36	•
Flame Cutting Machines (not hand)	219	113	22
HEATING EQUIPMENT	876	431	127
Heat-treating furnaces	332	178	54
Atmosphere generators	18	•	•
Stock-heating furnaces	153	69	35
Salt baths	115	78	•
Induction heating units	46	16	•
Baking and drying ovens	195	87	33
Flame-hardening units	17	•	•
CLEANING AND FINISHING	633	260	80
Cleaning Equipment	544	247	75
Barrel finishing machines	105	53	•
Shot and abrasive blast	94	59	14
Parts washing machines (incl degreasers)	336	135	52
Pickling machines	•	•	•
Plating Equipment	89	13	•
Machines	28	•	•
Barrels	61	•	•
INDUSTRIAL TRUCKS (Power-Driven)	1,335	686	59
Lift (rider-type)	457	187	31
Truck-tractor	116	44	12
Powered hand trucks	573	350	•
Crane trucks	189	105	•
OTHER SHOP EQUIPMENT	571	237	37
Balancing Machines	35	17	•
Air Compressors	470	198	37
Gear-Checking Machines	66	22	•

Seattle — Portland

All of the states of Washington and Oregon

388 plants — 94,877 employees

	Total Units	10 yr & over	Over 20 yr
METAL CUTTING	12,135	67%	17%
METAL FORMING	3302	72	25
OTHER EQUIPMENT	6725	63	5
TOTAL	22,162	67	15

• – Less than 10

	TOTAL	10-20 YEARS	OVER 20 YR
METAL-CUTTING MACHINES	12,135	6,099	2,029
Boring Machines	466	199	138
Horizontal boring, drilling, & milling	235	86	50
Vertical boring mills incl vert turret lathes	201	94	88
Precision, horizontal and vertical	15	14	•
Jig boring, horizontal and vertical	14	•	•
Other (except boring lathes)	•	•	•
Broaching Machines	67	44	•
Horizontal internal or combination	37	26	•
Horizontal surface	•	•	•
Vertical internal	11	•	•
Vertical surface or combination	15	•	•
Continuous horizontal & vertical	•	•	•
Other (incl rotary surface)	•	•	•
Contour Sawing and Filing	92	48	•
Cutoff Machines	1,478	796	93
Bandsaw (incl friction)	672	314	19
Abrasive disk	172	56	29
Hacksaws	337	192	41
Circular (incl friction)	205	156	•
Other	92	78	•
Drilling Machines	2,468	1,234	365
Sensitive	240	127	18
Upright: Single-spindle	1,240	619	205
Gang	75	23	•
Radial	428	205	63
Multi-spindle cluster, adjustable and fixed center	127	59	28
Automatic	45	18	•
Unit head & way type (not dial)	58	19	•
Deep-hole drills	•	•	•
Other (not incl special machines)	248	160	43
Gear Cutting and Finishing Machines	275	119	77
Hobbing machines, gear	178	64	48
Shapers, gear	41	28	•
Form-milling type (spur and bevel)	41	19	19
Bevel-gear cutters (not planer)	•	•	•
Grinders, gear tooth	•	•	•
Shavers, gear tooth	•	•	•
Burnishing and lapping	•	•	•
Chamfering, tooth pointing, tooth rounding	•	•	•
Other	•	•	•
Grinding Machines	2,559	1,474	356
External cylindrical: Plain	119	53	25
Universal	64	37	•
Internal cylindrical	52	25	•
Centerless: External	41	26	•
Internal	•	•	•
Surface: Rotary-table type	62	33	15
Reciprocating type	140	62	16
Disk, horizontal and vertical	51	20	18
Tool and cutter (incl drill)	405	196	61
Bench, floorstand, and snag	1,326	891	146
Jig grinders	•	•	•
Contour grinders	14	•	•
Abrasive belt (not polishing)	183	96	26
Other (except thread grinders)	96	35	36
Honing and Lapping	88	41	•
Honing: Internal (incl combination)	71	30	•
External and surface	•	•	•
Lapping: Surface	11	10	•
Cylindrical	•	•	•
Other (incl combination hone-lap)	•	•	•
Lathes	1,995	1,021	442
Bench, floor, ll-dy (incl turret attachment)	305	177	45
Engine, heavy-duty: Standard	722	312	237
Toolroom	292	175	74
Manufacturing and gap	56	30	16
Tracer	25	•	•
Turret lathes: Ram type	242	117	46
Saddle type	186	129	•
Auto chucking & between centers (single spindle)	•	•	•
Automatic chucking (multi-spindle)	•	•	•
Automatic screw machines (single spindle)	68	36	10
Automatic bar machines (multi-spindle)	30	12	10
Other (except spinning lathes)	53	30	•
Milling Machines	872	408	139
Bench type	36	13	13
Hand	29	15	•
Knee-type: Horizontal (plain & universal)	385	156	65
Vertical	79	28	•
Automatic & manufacturing	59	32	12
Ram type, swivel head	29	•	•
Bed (Lincoln) type, incl automatic rise and fall	40	27	•
Planer type (incl skin and spar)	57	15	12
Profilers, duplicators, diesinkers, engravers	59	40	•
Other (except thread milling)	99	80	17
Planers	194	62	106
Double housing	125	34	83
Openside and other	69	28	23
Pipe Cutting and Threading Machines	269	158	42
Polishing and Buffing Machines	677	200	94
Polishing stands (bench and floor)	183	70	64
Speed lathes	52	21	•
Abrasive-belt, disk, drum	407	93	21
Other	35	16	•
Shapers	352	178	110
Horizontal	273	138	89
Vertical, incl slotters & keyseaters	79	40	21
Threading (except pipe)	223	102	49
Tapping	158	75	30
Hobbing and milling	•	•	•
Die type	30	•	•
Grinders, thread	18	16	•
Rolling machines, thread	•	•	•
Other	10	•	•

	TOTAL	10-20 YEARS	OVER 20 YR
Electro-Erosion Machines (exc Tap disintegrators)	•	•	•
Ultrasonic Cutting Machines	•	•	•
Special Multi-Station Machines	27	11	•
In-line and transfer	•	•	•
Dial or rotary table	26	11	•
Automatic assembly (all types)	•	•	•
Other Metal-Cutting Machines	33	•	15
METAL-FORMING MACHINES	3,302	1,547	822
Bending and Forming Machines (Power)	725	391	141
Bending rolls, sheet and plate	267	176	68
Bending rolls, bars and shapes	72	40	19
Bending brakes	260	122	33
Rotary bending and forming machines	12	•	•
Bending machines, pipe, bar, and shapes	114	44	21
Wire and Strip Forming Machines	•	•	•
Hydraulic Presses	294	153	57
Vertical, single-action	208	115	26
Vertical, double and triple action	26	14	•
Horizontal	53	17	25
Extrusion (from hot billets)	•	•	•
Other (incl stretch and hydro-pneumatic)	•	•	•
Pneumatic Presses (except hydro-pneumatic)	•	•	•
Mechanical Presses (Power)	891	293	324
Inclinable, single-action (incl inclined)	446	190	176
Vertical, single-action: Straight-side (incl arch)	86	47	35
Vertical, single-action: Gap or C-frame	265	16	78
Vertical, single-action: Adjust. bed and horning	28	13	13
Double and triple action	•	•	•
Dieing machines	•	•	•
Horizontal (incl bulldozers)	20	17	•
Multiple transfer (incl eyeletting)	•	•	•
Other	35	•	22
Punching and Shearing Machines	1,004	578	201
Punching machines (incl turret)	290	157	69
Plate and sheet shears	391	235	85
Bar and angle shears	117	60	35
Rotary shears, incl slitters	80	54	•
Nibbling machines	92	53	•
Other	34	19	•
Forging Machinery (except presses)	125	37	63
Hammers, steam or air	46	20	18
Hammers, mechanical (incl drop and helve)	43	•	31
Forging machines (headers) and rolls	23	•	•
Swaging machines	•	•	•
Other	13	•	•
Riveting Machines (not portable)	190	51	32
Squeeze type	139	22	28
Rotary-vibrating type	•	•	•
Spinning type	•	•	•
Hammer type	50	29	•
Die Casting Machines	50	37	•
Hot chamber	26	17	•
Cold chamber	24	20	•
Plastics Molding Machines	•	•	•
Injection	•	•	•
Compression	•	•	•
Extrusion	•	•	•
WELDING EQUIPMENT	4,689	2,863	195
Electric Welding Equipment	4,326	2,570	190
Power source: Motor-generator set	1,838	1,418	40
Transformer and rectifier	1,121	477	•
Arc-weld machines (not hand) incl automatic	915	499	52
Resistance welders: Spot	263	108	66
Gun (not hand)	138	37	15
Seam	25	•	13
Butt and flash	26	26	•
Gas Welding Machines (not hand)	29	21	•
Flame Cutting Machines (not hand)	334	272	•
HEATING EQUIPMENT	646	368	94
Heat-treating furnaces	400	238	71
Atmosphere generators	•	•	•
Stock-heating furnaces	17	•	•
Salt baths	27	15	•
Induction heating units	•	•	•
Baking and drying ovens	182	102	15
Flame-hardening units	10	•	•
CLEANING AND FINISHING	483	203	16
Cleaning Equipment	403	202	16
Barrel finishing machines	53	13	•
Shot and abrasive blast	197	133	•
Parts washing machines (incl degreasers)	141	49	•
Pickling machines	12	•	•
Plating Equipment	80	•	•
Machines	66	•	•
Barrels	14	•	•
INDUSTRIAL TRUCKS (Power-Driven)	562	180	•
Lift (rider-type)	383	111	•
Truck-tractor	24	•	•
Powered hand trucks	44	14	•
Crane trucks	111	55	•
OTHER SHOP EQUIPMENT	527	266	51
Balancing Machines	36	17	•
Air Compressors	485	249	45
Gear-Checking Machines	•	•	•

575 plants 102,575 — employees

	Total Units	10 yr & over	Over 20 yr
METAL CUTTING	21,230	58%	17%
METAL FORMING	5972	55	12
OTHER EQUIPMENT	12,646	33	3
TOTAL	39,848	50	11

• — Less than 10

San Francisco

California north of a line that includes counties of Monterey, Fresno, and Mono; Nevada north of a line that includes counties of Mineral, Churchill, Lander, Eureka, and White Pine

	TOTAL	10-20 YEARS	OVER 20 YR
METAL-CUTTING MACHINES	21,230	8,747	3,618
Boring Machines	1,082	366	276
Horizontal boring, drilling, & milling	369	149	63
Vertical boring mills incl vert turret lathes	496	163	185
Precision, horizontal and vertical	56	•	17
Jig boring, horizontal and vertical	97	15	11
Other (except boring lathes)	64	13	•
Broaching Machines	100	38	18
Horizontal internal or combination	31	16	10
Horizontal surface	•	•	•
Vertical internal	52	20	•
Vertical surface or combination	•	•	•
Continuous horizontal & vertical	•	•	•
Other (incl rotary surface)	10	•	•
Contour Sawing and Filing	171	79	13
Cutoff Machines	1,515	653	112
Bandsaw (incl friction)	596	226	15
Abrasive disk	128	68	13
Hacksaws	503	267	78
Circular (incl friction)	221	54	•
Other	67	38	•
Drilling Machines	4,144	1,640	642
Sensitive	710	237	119
Upright: Single-spindle	1,871	770	253
Gang	427	170	83
Radial	751	325	136
Multi-spindle cluster, adjustable and fixed center	111	38	12
Automatic	27	•	•
Unit head & way type (not dial)	•	•	•
Deep-hole drills	12	•	•
Other (not incl special machines)	231	91	33
Gear Cutting and Finishing Machines	269	118	102
Hobbing machines, gear	122	60	36
Shapers, gear	48	19	24
Form-milling type (spur and bevel)	45	•	39
Bevel-gear cutters (not planer)	19	12	•
Grinders, gear tooth	•	•	•
Shavers, gear tooth	•	•	•
Burnishing and lapping	•	•	•
Chamfering, tooth pointing, tooth rounding	•	•	•
Other	14	10	•
Grinding Machines	4,455	2,063	602
External cylindrical: Plain	301	111	101
Universal	108	41	12
Internal cylindrical	124	57	48
Centerless: External	34	14	•
Internal	•	•	•
Surface: Rotary-table type	103	53	20
Reciprocating type	393	161	32
Disk, horizontal and vertical	92	59	23
Tool and cutter (incl drill)	895	320	131
Bench, floorstand, and snag	1,870	1,058	206
Jig grinders	16	•	•
Contour grinders	•	•	•
Abrasive belt (not polishing)	327	104	•
Other (except thread grinders)	188	81	21
Honing and Lapping	245	52	63
Honing: Internal (incl combination)	91	22	•
External and surface	•	•	•
Lapping: Surface	43	•	•
Cylindrical	101	24	58
Other (incl combination hone-lap)	•	•	•
Lathes	4,743	2,153	1,010
Bench, floor, ft-dy (incl turret attachment)	610	181	150
Engine, heavy-duty: Standard	1,992	756	437
Toolroom	533	249	111
Manufacturing and gap	74	25	•
Tracer	44	•	•
Turret lathes: Ram type	518	229	103
Saddle type	473	258	69
Auto chucking & between centers (single spindle)	100	38	11
Automatic chucking (multi-spindle)	31	17	•
Automatic screw machines (single spindle)	486	251	98
Automatic bar machines (multi-spindle)	163	93	14
Other (except spinning lathes)	119	56	13
Milling Machines	2,434	687	289
Bench type	99	63	•
Hand	248	150	49
Knee-type: Horizontal (plain & universal)	797	267	152
Vertical	577	112	32
Automatic & manufacturing	45	19	•
Ram type, swivel head	53	18	•
Bed (Lincoln) type, incl automatic rise and fall	85	•	14
Planer type (incl skin and spar)	•	•	•
Profilers, duplicators, diesinkers, engravers	489	29	31
Other (except thread milling)	36	20	•
Planers	228	86	122
Double housing	132	46	77
Openside and other	96	40	45
Pipe Cutting and Threading Machines	335	150	52
Polishing and Buffing Machines	551	238	78
Polishing stands (bench and floor)	287	141	54
Speed lathes	54	10	13
Abrasive-belt, disk, drum	186	79	•
Other	24	•	•
Shapers	570	284	149
Horizontal	401	214	97
Vertical, incl slotters & keyseaters	169	70	52
Threading (except pipe)	318	144	77
Tapping	102	30	23
Hobbing and milling	56	37	•
Die type	76	50	•
Grinders, thread	13	•	•
Rolling machines, thread	12	•	•
Other	59	15	37
Electro-Erosion Machines (exc Tap disintegrators)	•	•	•
Ultrasonic Cutting Machines	•	•	•
Special Multi-Station Machines	20	•	•
In-line and transfer	•	•	•
Dial or rotary table	12	•	•
Automatic assembly (all types)	•	•	•
Other Metal-Cutting Machines	44	11	11
METAL-FORMING MACHINES	5,972	2,573	720
Bending and Forming Machines (Power)	1,134	461	96
Bending rolls, sheet and plate	298	159	49
Bending rolls, bars and shapes	125	36	16
Bending brakes	441	187	23
Rotary bending and forming machines	70	13	•
Bending machines, pipe, bar, and shapes	200	66	•
Wire and Strip Forming Machines	604	365	92
Hydraulic Presses	560	180	89
Vertical, single-action	393	153	43
Vertical, double and triple action	30	•	•
Horizontal	86	22	39
Extrusion (from hot billets)	•	•	•
Other (incl stretch and hydro-pneumatic)	31	•	•
Pneumatic Presses (except hydro-pneumatic)	22	•	•
Mechanical Presses (Power)	1,371	571	160
Inclinable, single-action (incl inclined)	901	402	82
Vertical, single-action: Straight-side (incl arch)	93	30	13
Vertical, single-action: Gap or C-frame	191	83	40
Vertical, single-action: Adjust. bed and horning	17	•	•
Double and triple action	21	•	•
Dieing machines	•	•	•
Horizontal (incl bulldozers)	29	•	14
Multiple transfer (incl eyeletting)	23	•	•
Other	87	33	10
Punching and Shearing Machines	1,507	739	164
Punching machines (incl turret)	369	170	59
Plate and sheet shears	522	274	50
Bar and angle shears	299	114	38
Rotary shears, incl slitters	143	92	•
Nibbling machines	111	36	10
Other	63	53	•
Forging Machinery (except presses)	163	96	46
Hammers, steam or air	24	8	11
Hammers, mechanical (incl drop and helve)	71	54	14
Forging machines (headers) and rolls	29	21	•
Swaging machines	•	•	•
Other	31	10	21
Riveting Machines (not portable)	489	145	63
Squeeze type	163	30	10
Rotary-vibrating type	112	30	13
Spinning type	47	35	•
Hammer type	167	50	34
Die Casting Machines	12	•	10
Hot chamber	•	•	•
Cold chamber	11	•	10
Plastics Molding Machines	130	14	•
Injection	24	•	•
Compression	106	•	•
Extrusion	•	•	•
WELDING EQUIPMENT	7,918	1,967	111
Electric Welding Equipment	7,182	1,720	103
Power source: Motor-generator set	2,788	921	51
Transformer and rectifier	2,382	243	17
Arc-weld machines (not hand) incl automatic	1,039	314	11
Resistance welders: Spot	810	176	21
Gun (not hand)	104	31	•
Seam	32	15	•
Butt and flash	27	20	•
Gas Welding Machines (not hand)	158	44	•
Flame Cutting Machines (not hand)	578	203	•
HEATING EQUIPMENT	1,494	654	150
Heat-treating furnaces	581	268	91
Atmosphere generators	15	•	•
Stock-heating furnaces	202	72	29
Salt baths	85	36	26
Induction heating units	66	12	•
Baking and drying ovens	522	263	•
Flame-hardening units	23	•	•
CLEANING AND FINISHING	977	329	15
Cleaning Equipment	555	250	15
Barrel finishing machines	171	98	•
Shot and abrasive blast	181	108	•
Parts washing machines (incl degreasers)	161	40	•
Pickling machines	42	•	•
Plating Equipment	422	79	•
Machines	240	12	•
Barrels	182	67	•
INDUSTRIAL TRUCKS (Power-Driven)	1,367	378	19
Lift (rider-type)	768	222	•
Truck-tractor	206	13	•
Powered hand trucks	156	28	•
Crane trucks	237	115	14
OTHER SHOP EQUIPMENT	890	468	45
Balancing Machines	69	36	•
Air Compressors	768	404	41
Gear-Checking Machines	53	28	•

Los Angeles

California south of a line that includes counties of San Luis Obispo, Kings, Tulare, and Inyo; Nevada south of a line that includes counties of Esmeralda, Nye, and Lincoln; all of the state of Arizona

2041 plants — 563,240 employees

	Total Units	10 yr & over	Over 20 yr
METAL CUTTING	109,318	39%	4%
METAL FORMING	25,979	46	6
OTHER EQUIPMENT	31,501	33	3
TOTAL	166,798	39	4

• – Less than 10

	TOTAL	10-20 YEARS	OVER 20 YR
METAL-CUTTING MACHINES	109,318	38,774	4,276
Boring Machines	3,262	1,050	311
Horizontal boring, drilling, & milling	893	360	106
Vertical boring mills incl vert turret lathes	1,088	384	197
Precision, horizontal and vertical	298	102	•
Jig boring, horizontal and vertical	949	199	•
Other (except boring lathes)	36	•	•
Broaching Machines	610	221	23
Horizontal internal or combination	170	48	•
Horizontal surface	65	41	•
Vertical internal	190	83	•
Vertical surface or combination	128	32	•
Continuous horizontal & vertical	37	•	•
Other (incl rotary surface)	20	10	•
Contour Sawing and Filing	1,815	585	•
Cutoff Machines	7,236	2,396	207
Bandsaw (incl friction)	3,051	977	72
Abrasive disk	1,073	300	•
Hacksaws	1,913	763	97
Circular (incl friction)	1,065	332	24
Other	134	24	•
Drilling Machines	24,765	8,804	639
Sensitive	4,280	1,833	19
Upright: Single-spindle	12,331	4,536	403
Gang	3,198	784	38
Radial	2,078	800	86
Multi-spindle cluster, adjustable and fixed center	1,373	480	68
Automatic	298	11	•
Unit head & way type (not dial)	194	20	•
Deep-hole drills	115	11	•
Other (not incl special machines)	898	329	22
Gear Cutting and Finishing Machines	1,649	720	182
Hobbing machines, gear	587	272	85
Shapers, gear	508	204	30
Form-milling type (spur and bevel)	55	33	•
Bevel-gear cutters (not planer)	165	84	34
Grinders, gear tooth	120	42	•
Shavers, gear tooth	103	27	•
Burnishing and lapping	30	13	•
Chamfering, tooth pointing, tooth rounding	•	•	•
Other	75	42	23
Grinding Machines	22,351	8,145	554
External cylindrical: Plain	1,733	551	83
Universal	879	260	17
Internal cylindrical	752	284	50
Centerless: External	533	176	•
Internal	52	16	•
Surface: Rotary-table type	713	213	53
Reciprocating type	1,926	572	21
Disk, horizontal and vertical	1,348	466	19
Tool and cutter (incl drill)	3,701	1,333	123
Bench, floorstand, and snag	8,012	3,500	158
Jig grinders	61	•	•
Contour grinders	220	89	•
Abrasive belt (not polishing)	2,398	521	11
Other (except thread grinders)	523	164	•
Honing and Lapping	2,196	589	18
Honing: Internal (incl combination)	1,179	314	14
External and surface	83	10	•
Lapping: Surface	485	135	•
Cylindrical	300	83	•
Other (incl combination hone-lap)	149	47	•
Lathes	21,659	7,874	1,409
Bench, floor, lt-dy (incl turret attachment)	4,383	1,537	172
Engine, heavy-duty: Standard	4,838	1,907	562
Toolroom	2,676	693	110
Manufacturing and gap	441	157	51
Tracer	386	43	•
Turret lathes: Ram type	3,625	1,431	186
Saddle type	1,748	808	97
Auto chucking & between centers (single spindle)	810	195	58
Automatic chucking (multi-spindle)	169	77	•
Automatic screw machines (single spindle)	1,769	704	132
Automatic bar machines (multi-spindle)	489	178	•
Other (except spinning lathes)	325	144	31
Milling Machines	12,870	4,359	426
Bench type	794	186	•
Hand	1,219	553	69
Knee-type: Horizontal (plain & universal)	4,540	1,932	246
Vertical	3,271	814	31
Automatic & manufacturing	341	149	•
Ram type, swivel head	867	131	•
Bed (Lincoln) type, incl automatic rise and fall	241	102	•
Planer type (incl skin and spar)	204	63	20
Profilers, duplicators, diesinkers, engravers	1,229	356	39
Other (except thread milling)	164	73	•
Planers	496	188	124
Double housing	250	82	85
Openside and other	246	106	39
Pipe Cutting and Threading Machines	882	262	47
Polishing and Buffing Machines	4,412	1,462	66
Polishing stands (bench and floor)	1,688	667	28
Speed lathes	827	339	11
Abrasive-belt, disk, drum	1,434	353	•
Other	463	103	27
Shapers	1,737	895	216
Horizontal	1,431	773	176
Vertical, incl slotters & keyseaters	306	122	40
	2,690	1,109	28
Threading (except pipe)	1,183	373	18
Tapping	159	109	•
Hobbing and milling	165	76	•
Die type	499	328	•
Grinders, thread	638	199	•
Rolling machines, thread	46	24	•
Other			

	TOTAL	10-20 YEARS	OVER 20 YR
Electro-Erosion Machines (exc Tap disintegrators)	87	11	•
Ultrasonic Cutting Machines	27	•	•
Special Multi-Station Machines	330	31	•
In-line and transfer	43	•	•
Dial or rotary table	160	31	•
Automatic assembly (all types)	127	•	•
Other Metal-Cutting Machines	244	73	19
METAL-FORMING MACHINES	25,979	10,459	1,449
Bending and Forming Machines (Power)	4,637	1,512	227
Bending rolls, sheet and plate	938	334	95
Bending rolls, bars and shapes	229	110	16
Bending brakes	1,933	677	53
Rotary bending and forming machines	358	126	16
Bending machines, pipe, bar, and shapes	1,179	265	47
Wire and Strip Forming Machines	756	244	76
Hydraulic Presses	2,353	932	159
Vertical, single-action	1,824	728	140
Vertical, double and triple action	180	66	12
Horizontal	131	84	•
Extrusion (from hot billets)	•	•	•
Other (incl stretch and hydro-pneumatic)	218	54	•
Pneumatic Presses (except hydro-pneumatic)	306	81	•
Mechanical Presses (Power)	7,565	3,322	551
Inclinable, single-action (incl inclined)	4,255	1,856	293
Vertical, single-action: Straight-side (incl arch)	1,057	605	129
Vertical, single-action: Gap or C-frame	881	335	19
Vertical, single-action: Adjust. bed and horning	384	152	48
Double and triple action	129	43	•
Dieing machines	207	11	•
Horizontal (incl bulldozers)	61	25	•
Multiple transfer (incl eyeletting)	46	12	•
Other	545	283	57
Punching and Shearing Machines	4,472	1,719	326
Punching machines (incl turret)	1,106	344	118
Plate and sheet shears	1,715	746	112
Bar and angle shears	332	89	37
Rotary shears, incl slitters	531	194	23
Nibbling machines	525	274	18
Other	263	72	18
Forging Machinery (except presses)	1,035	535	99
Hammers, steam or air	160	78	29
Hammers, mechanical (incl drop and helve)	430	271	24
Forging machines (headers) and rolls	271	113	22
Swaging machines	112	56	17
Other	62	17	•
Riveting Machines (not portable)	4,212	1,963	11
Squeeze type	3,196	1,607	•
Rotary-vibrating type	167	40	•
Spinning type	139	45	•
Hammer type	710	271	•
Die Casting Machines	173	34	•
Hot chamber	97	10	•
Cold chamber	76	24	•
Plastics Molding Machines	470	117	•
Injection	102	28	•
Compression	330	89	•
Extrusion	38	•	•
WELDING EQUIPMENT	13,179	5,013	303
Electric Welding Equipment	12,690	4,851	293
Power source: Motor-generator set	4,832	2,510	145
Power source: Transformer and rectifier	5,083	648	37
Arc-weld machines (not hand) incl automatic	1,020	307	13
Resistance welders: Spot	2,749	974	56
Resistance welders: Gun (not hand)	263	89	•
Resistance welders: Seam	276	116	•
Resistance welders: Butt and flash	467	207	39
Gas Welding Machines (not hand)	132	42	•
Flame Cutting Machines (not hand)	357	120	•
HEATING EQUIPMENT	5,408	1,537	60
Heat-treating furnaces	2,213	826	49
Atmosphere generators	210	19	•
Stock-heating furnaces	227	57	•
Salt baths	455	220	•
Induction heating units	409	89	•
Baking and drying ovens	1,823	297	•
Flame-hardening units	71	29	•
CLEANING AND FINISHING	4,166	922	363
Cleaning Equipment	2,463	769	363
Barrel finishing machines	1,269	150	331
Shot and abrasive blast	680	217	•
Parts washing machines (incl degreasers)	1,412	306	30
Pickling machines	102	16	•
Plating Equipment	703	153	•
Machines	340	98	•
Barrels	363	55	•
INDUSTRIAL TRUCKS (Power-Driven)	4,598	784	34
Lift (rider-type)	3,051	581	15
Truck-tractor	575	56	•
Powered hand trucks	720	68	•
Crane trucks	252	79	19
OTHER SHOP EQUIPMENT	4,150	1,236	97
Balancing Machines	287	67	•
Air Compressors	3,608	1,084	95
Gear-Checking Machines	255	85	•

Boring Machines

	Total Units	10 Yrs & Over	20 Yrs Over
Horizontal boring, drilling & milling	20,376	62%	19%
Vertical boring mills	18,002	73	26
Precision, horizontal & vertical	13,082	43	6
Jig boring, horizontal & vertical	8,889	42	7
Other (except boring lathes)	2,278	56	20
Total	62,627	58	18

• – Less than 10

	TOTAL BORING MACHINES			HORIZONTAL BORING, DRILLING, & MILLING			VERTICAL BORING MILLS INCL. VERT. TURRET LATHES			PRECISION, HORIZONTAL AND VERTICAL			JIG BORING, HORIZONTAL AND VERTICAL			OTHER (EXCEPT BORING LATHES)		
	TOTAL	10-20 YEARS	OVER 20 YR	TOTAL	10-20 YEARS	OVER 20 YR	TOTAL	10-20 YEARS	OVER 20 YR	TOTAL	10-20 YEARS	OVER 20 YR.	TOTAL	10-20 YEARS	OVER 20 YR	TOTAL	10-20 YEARS	OVER 20 YR
BY INDUSTRY																		
Farm Machinery	1,990	895	502	758	348	211	268	114	99	696	326	78	74	48	•	194	59	105
Const., Mining, Mat. Hdlg.	3,635	1,565	954	1,289	561	368	1,471	670	491	616	249	64	200	76	15	59	•	16
Metalworking Machinery	8,787	3,389	1,443	3,879	1,557	691	1,570	611	469	1,128	414	39	1,954	681	208	256	126	36
Special-Industry Machinery	3,885	1,630	1,064	1,551	648	395	1,410	622	583	354	123	21	415	197	53	155	40	12
General Industrial Equipment	6,863	3,328	1,398	1,904	861	427	2,443	1,188	711	1,763	950	95	519	230	71	234	99	94
Fabricated Metal Products	6,044	2,657	1,562	2,105	955	553	2,717	1,227	931	497	234	36	530	175	17	195	66	25
Office and Service Machines	1,362	543	296	254	130	55	335	81	169	455	225	11	306	105	59	12	•	•
Electrical Equipment	3,306	1,298	658	976	436	131	1,073	399	390	605	226	74	608	220	54	44	17	•
Household Appliances	1,114	473	151	274	125	56	138	51	20	583	252	38	90	42	18	29	•	19
Communications Equipment	1,227	257	11	417	124	•	229	40	•	84	13	•	468	74	•	29	•	•
Motor Vehicles and Parts	6,216	1,182	521	1,257	263	143	498	131	99	3,512	489	169	292	81	55	657	218	55
Complete Aircraft	701	294	•	147	84	•	64	26	•	118	45	•	367	136	•	•	•	•
Aircraft Engines, Props, Parts	6,201	3,043	255	1,566	823	61	1,738	777	97	1,529	852	52	1,269	528	39	99	63	•
Precision Mechanisms	1,241	522	66	304	124	22	160	73	17	235	136	•	520	177	20	22	12	•
Ordnance, Shipbuilding, Railroads	3,975	2,083	663	1,707	906	325	1,578	914	290	284	115	14	302	122	10	104	26	24
Forge Shops, Foundries, Misc.	6,080	2,328	1,483	1,968	812	526	2,310	1,015	848	623	259	36	975	172	21	184	70	52
Total	62,627	25,487	11,036	20,376	8,757	3,970	18,002	7,939	5,221	13,082	4,906	729	8,889	3,064	656	2,278	819	460
BY GEOGRAPHIC AREA																		
Boston	3,884	1,775	746	1,305	646	242	1,185	569	392	545	269	26	690	211	53	159	80	33
Bridgeport – Hartford	2,499	1,113	444	814	327	169	585	282	159	273	106	24	787	386	73	40	12	19
New York – Newark	5,143	2,546	755	1,828	1,003	292	1,550	753	391	626	362	•	1,021	357	54	118	71	15
Buffalo – Syracuse	2,727	1,308	682	945	513	189	1,052	510	400	305	129	15	298	126	23	127	30	55
Philadelphia – Camden	2,703	1,097	664	1,019	421	274	1,000	474	330	292	87	•	304	91	18	88	24	42
Pittsburgh – Wheeling	2,075	963	580	992	470	266	812	400	281	29	10	•	167	72	10	75	11	18
Baltimore	1,136	396	219	388	140	81	361	119	104	217	64	18	148	62	•	22	11	•
Richmond	1,012	455	145	464	177	62	424	239	81	65	21	•	59	18	•	•	•	•
Atlanta – New Orleans	1,284	478	411	481	131	169	518	224	218	129	69	•	135	50	15	21	•	•
Cleveland	4,081	1,680	764	1,311	500	298	1,062	416	398	1,143	514	22	469	207	37	96	43	•
Toledo	1,530	463	166	422	195	67	316	119	76	675	107	18	81	34	•	36	•	•
Cincinnati – Louisville	3,182	1,224	585	990	446	141	771	340	218	904	233	118	408	172	63	109	33	45
Detroit	8,584	2,804	829	2,569	822	303	934	388	194	3,229	993	150	1,307	379	128	545	222	54
Indianapolis	2,330	889	257	716	318	69	353	122	64	945	362	74	211	72	38	105	15	12
Chicago	8,216	3,429	1,478	2,272	1,038	583	2,794	1,272	642	2,005	771	147	865	300	71	280	48	35
Milwaukee	3,201	1,525	748	1,203	474	322	786	357	242	748	460	87	271	119	29	193	115	68
Minneapolis – St. Paul	604	288	144	175	85	50	248	122	94	51	22	•	108	37	•	22	22	•
St. Louis	1,168	474	264	235	149	37	479	161	188	192	78	•	142	35	•	120	51	33
Kansas City – Tulsa	636	248	173	241	79	80	239	106	85	64	38	•	90	24	•	•	•	•
Dallas – Houston	972	413	185	197	95	40	458	223	139	123	40	•	194	55	•	•	•	•
Denver	850	324	72	314	133	17	290	102	55	153	51	•	74	38	•	19	•	•
Seattle – Portland	466	199	138	235	86	50	201	94	88	15	14	•	14	•	•	•	•	•
San Francisco	1,082	346	276	369	149	63	496	163	185	56	•	17	97	15	11	64	13	•
Los Angeles	3,262	1,050	311	891	360	106	1,088	384	197	298	102	•	949	199	•	36	•	•
Total	62,627	25,487	11,036	20,376	8,757	3,970	18,002	7,939	5,221	13,082	4,908	729	8,889	3,064	656	2,278	819	460

Broaching Machines

	TOTAL BROACHING MACHINES			HORIZONTAL INTERNAL OR COMBINATION			HORIZONTAL SURFACE			VERTICAL INTERNAL			VERTICAL SURFACE OR COMBINATION			CONTINUOUS HORIZONTAL & VERTICAL			OTHER (INCL. ROTARY SURFACE)		
	TOTAL	10-20 YEARS	OVER 20 YR	TOTAL	10-20 YEARS	OVER 20 YR	TOTAL	10-20 YEARS	OVER 20 YR	TOTAL	10-20 YEARS	OVER 20 YR	TOTAL	10-20 YEARS	OVER 20 YR	TOTAL	10-20 YEARS	OVER 20 YR	TOTAL	10-20 YEARS	OVER 20 YR
BY INDUSTRY																					
Farm Machinery	572	289	96	274	153	49	72	25	14	133	50	33	93	61	•	•	•	•	•	•	•
Construction, Mining, Materials Handling	657	253	211	338	114	135	176	76	59	97	54	11	40	•	•	•	•	•	•	•	•
Metalworking Machinery	818	402	171	482	242	122	42	21	•	150	69	29	106	57	•	•	•	•	33	•	•
Special-Industry Machinery	469	210	172	272	125	100	20	12	•	126	53	56	25	17	•	21	•	11	•	•	•
General Industrial Equipment	1,530	774	357	837	426	237	110	68	18	302	147	64	239	119	36	•	•	•	34	14	•
Fabricated Metal Products	1,750	782	213	431	257	42	172	57	•	633	209	103	425	230	33	14	•	•	75	23	30
Office and Service Machines	492	236	67	126	45	34	87	46	10	95	67	11	167	78	•	13	•	•	•	•	•
Electrical Equipment	743	248	96	255	95	21	44	24	•	150	42	•	234	80	55	30	•	•	30	•	10
Household Appliances	178	111	13	64	39	•	23	23	•	49	33	•	41	15	•	•	•	•	•	•	•
Communications Equipment	106	47	11	34	18	•	•	•	•	32	•	•	23	17	•	•	•	•	•	•	•
Motor Vehicles and Parts	2,841	643	472	519	126	202	291	54	20	608	100	82	960	270	126	87	•	•	376	88	41
Complete Aircraft	65	41	•	20	14	•	•	•	•	•	•	•	•	•	•	•	•	•	32	18	•
Aircraft Engines, Propellers, and Parts	793	364	26	287	153	•	19	11	•	182	103	13	270	97	•	25	•	•	10	•	•
Precision Mechanisms	262	224	7	47	32	•	38	36	•	41	33	•	23	12	•	•	•	•	109	107	•
Ordnance, Shipbuilding, Railroads	503	265	67	313	180	34	30	•	•	44	23	•	91	46	13	•	•	•	25	10	•
Forge Shops, Foundries, Miscellaneous	720	365	189	275	127	90	125	23	67	136	90	12	152	94	20	•	•	•	29	29	•
Total	12,498	5,254	2,168	4,574	2,146	1,093	1,261	485	216	2,786	1,086	432	2,891	1,204	302	215	32	22	771	301	103
BY GEOGRAPHIC AREA																					
Boston	712	340	135	341	143	79	32	11	•	134	42	32	73	28	14	•	•	•	129	116	•
Bridgeport – Hartford	596	161	160	168	62	34	54	29	16	185	10	44	137	53	28	•	•	•	52	•	38
New York – Newark	788	391	88	401	188	67	45	15	•	108	71	18	185	85	•	•	•	•	42	28	•
Buffalo – Syracuse	541	241	82	208	92	48	87	52	•	61	15	18	171	78	•	•	•	•	13	•	•
Philadelphia – Camden	533	199	119	163	83	39	23	11	•	169	61	70	141	42	•	31	•	•	•	•	•
Pittsburgh – Wheeling	190	103	40	121	67	35	•	•	•	28	19	•	36	14	•	•	•	•	•	•	•
Baltimore	99	59	•	68	40	•	•	•	•	18	12	•	11	•	•	•	•	•	•	•	•
Richmond	146	78	•	74	45	•	13	•	•	53	25	•	•	•	•	•	•	•	•	•	•
Atlanta – New Orleans	160	89	16	50	20	16	18	18	•	66	34	•	19	17	•	•	•	•	•	•	•
Cleveland	862	415	181	393	233	105	89	12	16	195	111	39	152	47	15	23	10	•	10	•	•
Toledo	473	175	49	141	72	35	43	•	•	174	67	•	73	36	•	40	•	•	•	•	•
Cincinnati – Louisville	757	394	104	239	116	60	15	•	•	120	59	•	113	30	21	•	•	•	263	92	18
Detroit	2,211	784	374	451	213	140	261	83	35	450	145	56	867	323	108	33	•	12	149	20	23
Indianapolis	783	322	136	235	118	34	84	41	18	199	52	34	229	109	46	15	•	•	21	•	•
Chicago	1,735	784	324	743	327	191	226	77	53	326	138	50	396	227	28	•	•	•	37	10	•
Milwaukee	581	234	187	277	111	115	111	42	30	106	51	22	82	28	20	•	•	•	•	•	•
Minneapolis – St. Paul	177	76	59	101	40	34	18	•	13	48	25	12	•	•	•	•	•	•	•	•	•
St. Louis	154	109	20	63	48	15	•	•	•	46	20	•	31	27	•	•	•	•	•	•	•
Kansas City – Tulsa	97	37	23	45	21	•	33	13	13	14	•	•	•	•	•	•	•	•	•	•	•
Dallas – Houston	58	30	•	14	•	•	16	•	•	14	12	•	14	•	•	•	•	•	•	•	•
Denver	68	20	•	40	14	•	•	•	•	19	•	•	•	•	•	•	•	•	•	•	•
Seattle – Portland	67	44	•	37	26	•	•	•	•	11	•	•	15	•	•	•	•	•	•	•	•
San Francisco	100	38	18	31	16	10	•	•	•	52	20	•	•	•	•	•	•	•	10	•	•
Los Angeles	610	221	23	170	48	•	65	41	•	190	83	•	128	32	•	37	•	•	20	10	•
Total	12,498	5,254	2,168	4,574	2,146	1,093	1,261	485	216	2,786	1,086	432	2,891	1,204	302	215	32	22	771	301	103

	Total Units	10 Yrs & Over	Over 20 Yrs
Horizontal internal or combination	4,574	71%	24%
Horizontal surface	1,261	56	17
Vertical internal	2,786	54	15
Vertical surface or combination	2,891	52	10
Continuous horizontal & vertical	215	25	10
Other (incl. rotary surface)	771	52	13
Total	12,498	59	17

• – Less than 10

Contour Sawing & Filing, Cutoff Machines

	Total Units	10 Yrs & Over	Over 20 Yrs
Bandsaw (incl. friction)	37,279	48%	7%
Abrasive-disk	13,692	44	5
Hacksaws	27,511	62	14
Circular (incl. friction)	11,963	46	11
Other	4,485	44	12
Total	94,930	51	9
Total Contour Sawing & Filing	17,476	49	6

• – Less than 10

	CONTOUR SAWING & FILING			TOTAL CUTOFF MACHINES			BANDSAW (INCL. FRICTION)			ABRASIVE DISK			HACKSAWS			CIRCULAR (INCL. FRICTION)			OTHER		
	TOTAL	10-20 YEARS	OVER 20 YR	TOTAL	10-20 YEARS	OVER 20 YR	TOTAL	10-20 YEARS	OVER 20 YR	TOTAL	10-20 YEARS	OVER 20 YR	TOTAL	10-20 YEARS	OVER 20 YR	TOTAL	10-20 YEARS	OVER 20 YR	TOTAL	10-20 YEARS	OVER 20 YR
BY INDUSTRY																					
Farm Machinery	283	143	13	2,135	974	223	750	348	23	296	114	19	913	460	161	88	29	•	88	23	13
Construction, Mining, Materials Handling	518	261	14	3,804	1,437	382	1,362	531	107	438	138	28	1,488	578	191	437	162	56	79	28	•
Metalworking Machinery	2,118	862	116	6,125	2,455	553	2,598	1,052	166	898	429	55	1,946	956	252	499	163	64	194	55	16
Special-Industry Machinery	851	392	53	4,152	1,791	597	1,585	786	144	652	167	75	1,466	696	262	357	116	95	92	26	21
General Industrial Equipment	556	239	35	5,145	2,294	597	1,718	747	117	667	295	44	1,867	918	259	549	192	102	324	142	75
Fabricated Metal Products	3,896	1,834	227	26,498	10,863	2,194	10,298	4,167	555	3,493	1,198	105	7,086	3,556	1,013	4,171	1,433	400	1,450	509	121
Office and Service Machines	804	346	120	3,098	1,266	482	1,243	511	154	416	147	46	833	363	179	420	179	53	186	66	50
Electrical Equipment	1,119	460	137	7,368	2,832	796	2,786	1,146	243	981	274	48	1,963	832	277	1,184	448	187	454	140	41
Household Appliances	266	98	41	1,175	459	132	539	195	44	106	48	•	272	120	52	137	64	24	141	32	•
Communications Equipment	702	258	25	3,076	950	144	1,322	428	55	410	130	•	726	260	45	416	97	17	202	35	23
Motor Vehicles and Parts	490	150	94	4,286	1,482	445	1,906	621	184	606	189	62	935	432	121	382	121	21	457	119	57
Complete Aircraft	826	395	•	2,247	971	20	1,072	424	11	208	60	•	362	218	•	490	238	•	115	31	•
Aircraft Engines, Propellers, and Parts	1,331	441	34	5,178	2,309	118	2,280	875	31	1,084	633	14	1,232	601	66	511	196	•	71	•	•
Precision Mechanisms	823	355	72	3,234	1,332	266	1,235	503	75	630	250	39	960	432	127	329	118	17	80	49	•
Ordnance, Shipbuilding, Railroads	721	439	40	4,070	2,303	466	1,108	626	118	894	454	65	1,539	953	172	328	163	81	201	107	30
Forge Shops, Foundries, Miscellaneous	2,162	931	96	13,339	5,514	1,561	5,497	2,252	530	1,893	757	99	3,923	1,892	665	1,675	540	176	351	73	91
Total	17,476	7,604	1,117	94,930	39,432	8,976	37,279	15,212	2,557	13,692	5,283	710	27,511	13,247	3,847	11,963	4,251	1,305	4,485	1,439	557
BY GEOGRAPHIC AREA																					
Boston	1,195	599	98	6,417	2,763	965	2,333	958	247	1,003	345	74	2,002	1,007	394	777	338	187	302	115	63
Bridgeport – Hartford	807	329	125	3,140	1,219	604	1,218	462	69	511	214	23	892	395	187	349	105	92	150	43	33
New York – Newark	1,655	870	57	9,098	4,060	751	3,172	1,316	171	1,693	809	72	2,467	1,142	311	1,357	545	126	409	168	71
Buffalo – Syracuse	681	349	55	4,160	1,696	484	1,426	623	96	666	274	53	1,322	561	240	503	170	69	243	68	26
Philadelphia – Camden	777	414	26	5,406	2,360	561	1,990	901	160	1,007	383	67	1,679	834	234	495	163	72	235	79	28
Pittsburgh – Wheeling	594	293	•	3,816	1,598	469	1,240	536	103	382	150	41	1,230	676	169	638	176	134	326	60	22
Baltimore	323	174	25	1,460	701	187	502	223	66	285	142	•	420	216	80	225	113	25	28	•	10
Richmond	323	120	•	2,257	976	161	872	403	20	459	159	24	695	313	84	169	50	•	102	51	24
Atlanta – New Orleans	370	219	14	3,268	1,332	251	1,135	527	64	525	125	21	1,073	545	119	451	110	42	84	25	•
Cleveland	789	310	72	4,779	1,959	573	1,822	770	184	603	246	22	1,441	713	231	712	203	127	201	27	39
Toledo	208	72	•	1,111	457	75	450	197	17	145	73	•	278	132	33	188	53	10	50	•	10
Cincinnati – Louisville	830	413	81	3,823	1,595	486	1,594	623	174	517	215	19	1,194	577	247	259	109	30	259	71	16
Detroit	1,517	538	198	7,846	3,129	834	3,510	1,352	379	958	401	65	1,836	869	214	738	287	58	804	220	118
Indianapolis	434	237	45	2,377	1,168	280	932	470	96	283	94	22	673	361	104	320	151	56	169	92	•
Chicago	2,446	998	131	13,208	5,425	1,154	5,535	2,171	400	1,640	606	94	3,785	1,827	522	1,800	635	113	448	186	25
Milwaukee	710	320	76	3,333	1,479	340	1,229	546	66	520	197	18	1,222	640	195	306	89	39	56	•	22
Minneapolis – St. Paul	389	117	15	1,501	542	156	651	236	27	148	52	•	533	214	101	137	21	25	32	19	•
St. Louis	520	268	56	2,211	1,184	189	935	544	47	252	81	17	597	344	67	336	172	25	91	43	33
Kansas City – Tulsa	223	96	•	1,808	704	112	924	327	39	161	60	•	434	204	46	249	105	24	40	•	•
Dallas – Houston	388	143	•	2,666	698	85	1,105	317	33	381	57	11	664	242	59	342	69	•	154	•	•
Denver	219	103	•	1,016	547	47	385	193	23	180	96	•	341	213	14	101	45	10	•	•	•
Seattle – Portland	92	48	•	1,478	796	93	672	314	19	172	56	29	337	192	41	265	156	•	92	78	•
San Francisco	171	79	13	1,515	653	112	596	226	15	128	68	13	503	267	78	221	54	•	67	38	•
Los Angeles	1,815	588	•	7,236	2,396	297	3,051	977	72	1,073	300	•	1,933	763	97	1,065	332	24	134	24	•
Total	17,476	7,604	1,117	94,930	39,432	8,976	37,279	15,212	2,557	13,692	5,283	710	27,511	13,247	3,847	11,963	4,251	1,305	4,485	1,439	557

Drilling Machines

	Total Units	10 Yrs & Over	Over 20 Yrs
Sensitive	64,467	61%	16%
Upright, sing. spdl	166,399	58	15
Upright, gang	39,079	60	15
Radial	39,411	65	20
Multi-spdl. cluster	18,558	58	17

	Total Units	10 Yrs & Over	Over 20 Yrs
Automatic	5,246	33%	7%
Unit head & way	4,331	47	14
Deep-hole drills	2,482	59	23
Other	17,816	56	18
Total	357,789	59	16

◆ – Less than 10

	TOTAL DRILLING MACHINES			SENSITIVE			UPRIGHT, SINGLE SPINDLE			UPRIGHT, GANG			RADIAL			MULTI-SPINDLE CLUSTER, ADJUSTABLE & FIXED CENTER			AUTOMATIC			UNIT HEAD & WAY TYPE (NOT DIAL)			DEEP-HOLE DRILLS			OTHER		
	TOTAL	10-20 YEARS	OVER 20 YR	TOTAL	10-20 YEARS	OVER 20 YR	TOTAL	10-20 YEARS	OVER 20 YR	TOTAL	10-20 YEARS	OVER 20 YR	TOTAL	10-20 YEARS	OVER 20 YR	TOTAL	10-20 YEARS	OVER 20 YR	TOTAL	10-20 YEARS	OVER 20 YR	TOTAL	10-20 YEARS	OVER 20 YR	TOTAL	10-20 YEARS	OVER 20 YR	TOTAL	10-20 YEARS	OVER 20 YR
BY INDUSTRY																														
Farm Machinery	12,510	5,685	3,640	1,196	599	239	5,308	2,208	1,612	1,445	751	315	1,879	848	502	1,101	528	325	58	30	◆	825	348	251	82	44	14	1,024	328	379
Const., Mining, Mat. Hdlg.	13,563	5,841	2,772	1,177	551	116	5,370	2,517	1,203	799	376	156	4,315	1,721	899	1,260	447	357	84	◆	◆	69	21	◆	163	92	◆	310	107	26
Metalworking Machinery	25,749	11,660	3,636	4,334	2,022	624	11,325	5,130	1,439	3,004	1,491	631	5,109	2,357	868	765	277	144	247	61	◆	151	50	16	187	54	25	627	218	90
Special-Industry Machinery	16,647	8,542	3,276	2,533	1,308	331	7,068	3,530	1,440	2,749	1,530	563	2,930	1,436	696	734	370	157	101	35	◆	34	17	◆	55	17	13	445	253	69
General Industrial Equipment	25,827	12,775	4,070	3,847	1,850	913	9,804	4,900	1,739	3,634	1,906	512	4,254	2,190	879	2,104	914	491	603	259	45	285	87	28	304	196	48	992	393	223
Fabricated Metal Products	29,566	10,715	10,180	7,210	2,714	494	13,565	6,522	6,063	4,773	2,012	788	6,627	3,098	1,475	3,737	1,562	539	1,721	322	211	656	233	108	311	69	35	3,586	1,488	477
Office and Service Machines	19,028	8,462	4,213	7,089	3,446	1,083	6,053	2,695	1,249	2,706	1,103	511	1,124	540	249	995	385	276	451	198	28	13	◆	◆	33	◆	14	483	147	189
Electrical Equipment	27,154	10,882	4,427	7,622	2,971	2,035	11,369	4,415	1,105	2,246	1,008	212	1,908	781	454	1,397	559	151	307	28	19	147	52	13	88	23	11	2,070	985	347
Household Appliances	7,884	3,846	1,474	1,085	463	282	4,423	2,248	898	909	554	181	279	99	50	359	120	25	144	78	◆	150	31	33	66	37	◆	499	216	89
Communications Equipment	13,450	5,226	782	2,279	788	173	7,011	2,878	282	2,204	767	199	822	159	48	670	164	19	149	15	◆	26	12	◆	34	19	◆	675	454	66
Motor Vehicles and Parts	24,258	7,416	6,765	4,461	1,436	1,318	9,308	3,174	3,079	2,006	803	628	1,439	484	330	1,447	378	385	273	49	27	789	161	129	150	53	25	4,385	788	844
Complete Aircraft	6,605	4,007	43	3,223	2,125	◆	2,189	1,704	◆	281	78	30	592	306	◆	138	97	◆	18	◆	◆	◆	◆	◆	◆	◆	◆	157	125	◆
Aircraft Engines, Props, Parts	24,150	10,572	564	4,119	2,050	93	11,115	4,647	253	3,789	1,722	78	2,470	1,057	79	1,463	724	15	285	77	◆	149	40	12	108	59	10	573	196	24
Precision Mechanisms	20,731	9,080	2,213	4,633	2,402	442	10,076	4,185	1,037	3,634	1,437	432	838	282	73	1,057	467	166	218	35	◆	157	14	◆	28	13	◆	370	245	57
Ordnance, Shipbuilding, Railroads	13,183	6,804	2,948	5,398	2,751	1,311	3,327	1,754	642	1,171	593	190	2,176	1,298	381	227	100	59	27	12	◆	108	48	◆	542	155	305	207	91	55
Forge Shops, Foundries, Misc.	36,084	14,129	4,531	4,261	1,677	396	20,088	8,241	2,440	3,529	1,248	546	3,421	1,451	820	2,879	455	159	560	149	◆	766	311	◆	246	69	48	1,304	524	212
TOTAL	357,789	155,133	56,312	64,467	29,229	10,292	166,399	72,219	24,558	39,079	17,649	5,752	39,411	18,030	7,800	18,558	7,535	3,248	5,246	1,357	351	4,331	1,429	610	2,482	905	572	17,816	6,780	3,129
BY GEOGRAPHIC AREA																														
Boston	25,789	12,074	4,594	5,084	3,563	840	10,615	4,375	1,807	3,442	1,374	850	2,882	1,421	619	961	473	137	293	105	25	114	27	37	156	89	38	1,212	647	241
Bridgeport – Hartford	18,754	7,677	3,038	5,231	2,823	742	7,740	2,968	944	2,453	1,153	403	1,014	431	227	911	351	173	196	61	35	261	61	33	406	79	280	1,042	547	203
New York – Newark	22,850	15,275	3,776	8,304	2,530	538	16,766	7,719	1,793	3,989	1,966	425	2,960	1,311	612	1,278	642	202	533	166	◆	572	300	16	209	77	15	1,231	556	173
Buffalo – Syracuse	14,916	6,908	2,709	3,076	1,389	697	5,829	2,668	1,047	1,780	941	325	1,676	778	439	1,035	601	141	295	59	16	133	47	13	30	11	◆	1,043	457	91
Philadelphia – Camden	16,245	7,321	2,202	2,538	1,005	199	7,443	3,708	1,058	2,236	810	245	2,324	1,158	523	777	266	98	189	49	10	64	◆	◆	130	53	29	524	260	32
Pittsburgh – Wheeling	7,551	3,292	1,833	1,277	490	313	3,123	1,458	602	339	170	51	1,816	848	492	347	183	56	44	19	◆	52	22	◆	37	19	12	516	93	307
Baltimore	6,228	2,718	1,290	2,915	1,193	817	1,928	894	234	444	188	49	595	278	130	156	40	36	27	◆	10	21	12	◆	33	17	◆	109	86	◆
Richmond	6,583	2,881	720	1,977	856	263	3,001	1,306	221	348	195	30	790	315	154	295	101	40	◆	◆	◆	17	17	◆	27	◆	◆	158	92	12
Atlanta – New Orleans	5,515	3,259	832	746	457	39	4,084	1,949	455	537	162	55	992	476	247	177	43	30	18	◆	◆	35	14	◆	75	48	◆	251	89	◆
Cleveland	18,831	9,077	3,066	3,073	1,799	253	7,931	3,406	1,533	2,516	1,316	378	2,671	1,448	436	1,456	654	144	462	81	151	166	56	12	108	28	14	748	209	125
Toledo	4,873	2,185	973	598	144	98	2,272	1,067	470	543	282	128	636	348	111	605	152	122	96	45	◆	62	28	12	23	20	◆	222	19	24
Cincinnati – Louisville	17,258	7,576	4,120	4,717	1,711	1,505	7,886	3,689	1,610	1,764	766	221	1,951	983	385	767	250	225	77	◆	◆	89	12	◆	61	11	◆	516	206	156
Detroit	30,316	13,075	6,579	6,368	2,457	1,293	16,043	6,680	3,000	3,261	1,614	606	2,561	1,381	568	1,266	402	238	750	238	11	637	177	103	245	110	22	3,777	816	791
Indianapolis	11,542	4,827	2,384	3,532	1,467	854	4,387	1,829	988	574	251	81	1,669	571	152	575	247	125	180	39	◆	177	41	35	105	50	13	944	322	123
Chicago	56,366	24,111	8,782	6,161	2,661	1,050	27,517	12,133	3,904	7,092	3,468	848	6,975	2,606	1,542	4,082	1,559	841	915	216	59	684	288	56	433	148	57	2,507	1,022	365
Milwaukee	20,678	9,329	4,088	1,972	981	290	10,614	4,728	2,303	2,560	1,232	689	1,593	998	492	1,312	531	364	435	209	◆	763	213	241	184	89	29	865	348	296
Minneapolis – St. Paul	5,570	2,150	662	273	123	27	3,443	1,399	408	650	233	39	642	292	105	340	75	73	89	12	◆	24	◆	◆	◆	◆	◆	186	16	◆
St. Louis	7,566	3,775	1,196	1,393	643	232	4,220	2,216	632	597	288	147	695	355	105	325	108	67	180	30	◆	100	◆	◆	14	◆	◆	199	126	13
Kansas City – Tulsa	3,788	1,577	490	598	232	32	2,077	801	264	219	106	34	446	218	106	110	65	16	27	◆	◆	94	56	34	21	◆	◆	176	92	◆
Dallas – Houston	5,660	1,855	435	496	185	10	3,419	1,070	283	231	75	10	742	292	119	378	118	◆	83	26	◆	11	◆	◆	21	◆	◆	171	89	◆
Denver	3,413	1,703	266	908	490	44	1,449	713	123	300	122	15	382	215	23	205	97	◆	41	◆	◆	19	◆	◆	27	16	◆	88	28	54
Minneapolis – St. Paul	5,570	2,150	662	273	123	27	3,443	1,399	408	650	233	39	642	292	105	340	75	73	89	12	◆	24	◆	◆	◆	◆	◆	186	16	◆
St. Louis	7,566	3,775	1,196	1,393	643	232	4,220	2,216	632	597	288	147	695	355	105	325	108	67	180	30	◆	100	◆	◆	14	◆	◆	199	126	13
Kansas City – Tulsa	3,788	1,577	490	598	232	32	2,077	801	264	219	106	34	446	218	106	110	65	16	27	◆	◆	94	56	34	21	◆	◆	176	92	◆
Dallas – Houston	5,660	1,855	435	496	185	10	3,419	1,070	283	231	75	10	742	292	119	378	118	◆	83	26	◆	11	◆	◆	21	◆	◆	171	89	◆
Denver	3,413	1,703	266	908	490	44	1,449	713	123	300	122	15	382	215	23	205	97	◆	41	◆	◆	19	◆	◆	27	16	◆	88	28	54
Seattle – Portland	2,468	1,234	385	240	127	18	1,240	619	205	75	23	◆	478	226	63	127	59	28	45	18	◆	58	19	◆	◆	◆	◆	248	160	43
San Francisco	4,144	1,640	642	710	237	119	1,871	770	253	427	170	83	761	325	136	111	38	12	27	◆	◆	◆	◆	◆	12	◆	◆	251	91	33
Los Angeles	24,765	8,864	639	4,286	1,833	19	12,331	4,536	403	3,198	784	38	2,678	600	86	1,373	480	68	298	11	◆	194	20	◆	115	11	◆	896	329	22
TOTAL	357,789	155,133	56,312	64,467	29,229	10,292	166,399	72,219	24,558	39,079	17,649	5,752	39,411	18,030	7,800	18,558	7,535	3,248	5,246	1,357	351	4,331	1,429	610	2,482	905	572	17,816	6,780	3,129

Gear Cutting and Finishing Machines

	Total Units	10 Yrs & Over	Over 20 Yrs
Hobbers, gear	16,841	66%	23%
Shapers, gear	9,492	68	18
Form millers	2,397	85	56
Bevel-gear cutters	4,769	59	22
Tooth grinders	2,087	58	9
Tooth shavers	2,520	47%	7%
Burnishing & lapping	1,637	49	19
Chamfer, tooth point	1,261	55	20
Other	1,226	62	33
Total	42,230	64	22

• – Less than 10

	TOTAL GEAR CUTTING & FINISHING MACHINES			HOBBING MACHINES, GEAR			SHAPERS, GEAR			FORM-MILLING TYPE (SPUR & BEVEL)			BEVEL-GEAR CUTTERS (NOT PLANER)			GRINDERS, GEAR TOOTH			SHAVERS, GEAR TOOTH			BURNISHING & LAPPING			CHAMFERING, TOOTH POINTING, TOOTH ROUNDING			OTHER		
	TOTAL	10-20 YEARS	OVER 20 YR	TOTAL	10-20 YEARS	OVER 20 YR	TOTAL	10-20 YEARS	OVER 20 YR	TOTAL	10-20 YEARS	OVER 20 YR	TOTAL	10-20 YEARS	OVER 20 YR	TOTAL	10-20 YEARS	OVER 20 YR	TOTAL	10-20 YEARS	OVER 20 YR	TOTAL	10-20 YEARS	OVER 20 YR	TOTAL	10-20 YEARS	OVER 20 YR	TOTAL	10-20 YEARS	OVER 20 YR
BY INDUSTRY																														
Farm Machinery	2,598	992	971	1,240	457	515	367	105	125	92	32	54	238	75	126	•	•	•	265	154	25	129	45	64	131	35	42	124	25	38
Const., Mining, Mat. Hdlg.	2,299	856	660	1,187	448	327	527	182	152	206	81	100	85	37	34	22	•	•	108	53	•	•	•	•	81	27	20	66	17	21
Metalworking Machinery	4,545	1,829	1,136	1,563	632	408	895	419	211	231	51	155	317	104	114	838	373	112	502	243	95	112	40	16	130	49	38	216	68	75
Special-Industry Machinery	1,882	810	732	742	320	291	587	307	206	231	82	117	157	65	58	34	10	•	32	11	•	34	•	23	26	•	•	39	•	30
General Industrial Equipment	9,505	5,014	2,086	4,317	2,122	961	2,199	1,311	231	700	160	469	978	548	149	486	283	19	502	243	15	255	121	74	166	82	38	333	134	130
Fabricated Metal Products	1,181	427	358	415	128	118	399	187	108	68	•	•	23	11	•	26	•	•	41	•	21	88	22	•	66	56	•	44	14	20
Office and Service Machines	1,245	344	479	691	180	227	211	103	36	239	20	201	47	20	•	47	15	•	19	•	•	30	•	•	12	•	•	39	•	•
Electrical Equipment	1,138	386	253	467	141	58	248	125	30	53	11	•	233	55	127	43	28	•	20	10	•	23	16	•	16	16	•	30	•	•
Handtools& Appliances	577	394	45	241	147	26	215	183	•	•	•	•	28	•	19	14	11	•	47	23	•	26	18	•	16	•	•	90	31	18
Communications Equipment	667	201	74	458	135	16	80	42	•	58	•	30	•	•	•	78	26	18	21	12	•	•	•	•	16	•	16	14	•	80
Motor Vehicles and Parts	8,679	2,092	1,682	2,566	652	602	1,510	489	328	68	•	38	2,133	540	352	78	26	18	836	193	72	699	91	144	558	140	81	260	57	27
Complete Aircraft	104	•	•	73	•	•	28	•	•	•	•	•	•	•	•	36	•	•	51	•	20	41	21	•	51	•	•	45	10	21
Aircraft Engines, Props, Parts	2,579	1,616	170	778	435	86	880	616	58	32	21	•	214	120	•	382	179	14	217	125	•	81	74	•	33	22	•	42	22	•
Precision Mechanisms	1,889	1,314	156	1,199	884	69	165	100	11	201	136	55	102	73	•	62	35	•	65	47	•	83	27	•	14	•	•	12	•	•
Ordnance, Shipbuilding, Railroads	1,159	718	137	414	264	40	333	202	46	102	64	27	155	96	11	99	29	•	47	28	•	13	•	•	76	28	26	22	20	•
Forge Shops, Foundries, Misc.	1,722	744	388	542	230	92	839	424	142	117	35	78	43	•	27	35	•	•	51	•	20	41	21	•	•	•	•	45	10	21
TOTAL	42,230	17,743	9,311	16,841	7,191	3,303	9,492	4,786	1,686	2,397	701	1,345	4,769	1,761	1,043	2,087	1,006	197	2,520	1,008	182	1,637	490	305	1,261	447	249	1,226	353	401
BY GEOGRAPHIC AREA																														
Boston	2,084	1,275	786	1,256	714	308	695	307	182	258	84	135	167	64	61	92	20	23	101	52	•	64	14	19	27	•	13	64	15	37
Bridgeport – Hartford	2,080	1,071	327	775	421	112	435	264	18	230	81	100	202	80	49	196	99	19	119	49	•	32	16	•	53	22	•	47	21	•
New York – Newark	3,031	1,597	537	887	396	137	958	627	118	138	89	40	538	215	100	118	91	•	117	66	•	197	104	•	94	26	•	83	31	46
Buffalo – Syracuse	2,065	828	306	610	255	115	589	270	123	61	19	23	399	123	21	71	29	•	145	55	•	56	20	•	15	•	•	88	22	22
Philadelphia – Camden	1,286	598	259	983	267	128	295	180	52	106	24	62	101	51	•	19	•	•	38	21	•	•	•	•	64	61	•	14	•	•
Pittsburgh – Wheeling	550	312	126	245	115	77	176	135	16	38	13	13	33	14	•	27	16	•	16	•	•	•	•	•	•	•	•	22	13	•
Baltimore	527	208	95	176	56	60	151	77	•	33	•	27	38	17	•	45	33	•	21	•	•	11	•	•	•	•	•	61	•	17
Richmond	642	273	110	235	121	28	225	98	53	35	•	18	107	50	16	21	•	•	•	•	•	•	•	•	•	•	•	•	•	•
Atlanta – New Orleans	613	282	201	157	65	65	164	96	27	93	31	47	50	23	19	47	10	•	38	25	13	17	•	12	•	•	•	98	31	18
Cleveland	3,566	1,340	981	1,610	559	301	728	386	103	491	134	332	408	133	120	65	25	•	184	58	11	102	36	•	76	28	26	91	•	80
Toledo	1,120	431	189	541	194	97	237	108	20	27	•	•	25	22	•	33	19	12	100	35	•	47	•	•	71	37	12	•	•	•
Cincinnati – Louisville	1,397	647	532	1,055	288	248	601	182	67	174	13	146	117	46	34	98	51	17	90	45	•	32	13	•	51	24	14	51	•	19
Detroit	7,825	2,428	1,465	2,191	740	491	1,440	532	265	94	17	48	1,586	313	305	809	451	38	664	188	73	500	77	77	361	79	68	210	51	40
Indianapolis	1,902	703	336	808	285	204	414	207	60	11	10	•	102	79	•	91	41	13	242	93	•	89	25	25	199	45	16	67	•	•
Chicago	5,775	2,386	1,625	3,242	1,421	855	936	358	318	253	58	101	347	169	125	116	38	61	332	176	29	184	60	49	161	47	48	284	59	59
Milwaukee	2,665	1,274	827	1,301	561	456	518	329	128	105	28	77	151	86	20	35	23	•	154	95	20	259	87	105	80	44	33	62	21	•
Minneapolis & St. Paul	624	439	74	243	146	34	169	124	22	24	•	11	127	115	•	•	•	•	27	18	•	•	•	•	18	10	•	23	23	•
St. Louis	577	225	77	90	44	25	201	157	18	24	•	20	28	15	•	•	•	•	16	•	•	•	•	•	•	•	•	•	•	•
Kansas City – Tulsa	230	124	52	106	62	32	48	41	•	13	•	13	35	•	•	•	•	•	•	•	•	11	10	•	•	•	•	•	•	•
Dallas – Houston	195	58	35	53	26	12	51	•	23	29	13	•	20	•	•	39	10	•	•	•	•	•	•	•	•	•	•	•	•	•
Denver	354	201	48	138	78	17	114	80	•	19	•	19	33	25	•	15	•	•	12	•	•	15	•	•	•	•	•	•	•	•
Seattle – Portland	275	119	77	178	64	48	41	28	•	41	19	19	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•	•
San Francisco	280	118	102	122	60	36	48	19	24	45	•	39	19	12	•	•	•	•	•	•	•	•	•	•	•	•	•	14	10	•
Los Angeles	1,649	720	182	587	272	85	508	264	30	55	33	•	185	84	34	120	42	•	103	27	•	30	13	•	•	•	•	75	42	23
TOTAL	42,230	17,743	9,311	16,841	7,191	3,303	9,492	4,786	1,686	2,397	701	1,345	4,769	1,761	1,043	2,087	1,006	197	2,520	1,008	182	1,637	490	305	1,261	447	249	1,226	353	401

Grinding Machines

	Total Units	10 Yrs & Over	Over 20 Yrs
External cylindrical, plain	28,574	68%	17%
External cylindrical, universal	12,049	59	12
Internal cylindrical	14,732	63	13
Centerless, external	12,200	56	9
Centerless, internal	2,484	61	16
Surface, rotary table	17,178	58	14
Surface, reciprocating	41,611	56	11
Disk, horizontal & vertical	13,684	60	17

* – Less than 10

	TOTAL GRINDING MACHINES			EXTERNAL CYLINDRICAL, PLAIN			EXTERNAL CYLINDRICAL, UNIVERSAL			INTERNAL CYLINDRICAL			CENTERLESS, EXTERNAL			CENTERLESS, INTERNAL			SURFACE, ROTARY-TABLE TYPE			SURFACE, RECIPRO-CATING TYPE		
	TOTAL	10-20 YEARS	OVER 20 YR	TOTAL	10-20 YEARS	OVER 20 YR	TOTAL	10-20 YEARS	OVER 20 YR	TOTAL	10-20 YEARS	OVER 20 YR	TOTAL	10-20 YEARS	OVER 20 YR	TOTAL	10-20 YEARS	OVER 20 YR	TOTAL	10-20 YEARS	OVER 20 YR	TOTAL	10-20 YEARS	OVER 20 YR
BY INDUSTRY																								
Farm Machinery	8,986	4,506	2,120	1,025	441	341	84	51	14	267	136	49	204	127	36	50	16	13	283	123	66	467	249	57
Const., Mining, Mat. Hdlg.	13,722	5,988	2,277	1,016	470	219	416	296	80	520	233	100	350	109	45	25	23	•	446	161	78	509	209	62
Metalworking Machinery	48,378	22,661	8,510	6,613	2,638	764	2,804	1,411	463	3,141	1,763	558	885	511	27	149	102	•	2,586	1,158	367	9,601	4,404	1,052
Special-Industry Machinery	15,626	8,161	2,700	1,432	745	421	498	238	95	405	250	71	209	112	51	22	18	•	631	324	142	1,725	914	227
General Industrial Equipment	36,228	17,392	6,321	3,858	2,133	672	1,147	601	176	3,012	1,519	453	2,320	1,033	361	1,473	621	295	2,058	1,137	293	1,932	1,007	270
Fabricated Metal Products	60,851	27,182	7,966	2,806	1,264	460	1,396	710	147	922	524	127	1,719	964	65	139	81	17	2,425	1,006	355	7,042	3,289	762
Office and Service Machines	14,096	6,664	2,486	752	358	115	269	115	42	266	151	44	237	99	44	33	29	•	385	194	48	2,248	1,045	420
Electrical Equipment	20,378	8,429	2,849	1,643	756	192	712	224	83	531	226	48	697	372	81	100	31	16	1,611	637	206	2,493	1,045	254
Household Appliances	5,355	2,828	612	448	285	64	157	102	•	210	120	30	517	248	15	45	17	•	406	195	58	638	325	61
Communications Equipment	10,218	3,500	591	487	218	19	357	116	24	156	25	11	164	78	16	12	•	•	485	117	25	2,303	766	152
Motor Vehicles and Parts	29,529	8,823	5,110	3,798	1,104	730	945	324	105	1,709	391	207	2,626	841	244	177	33	21	1,875	622	298	1,520	488	241
Complete Aircraft	5,357	2,783	55	133	64	•	163	47	•	37	22	•	77	30	•	•	•	•	66	32	•	280	133	•
Aircraft Engines, Props, Parts	24,426	12,417	696	2,287	1,495	103	1,151	516	68	1,811	1,072	49	841	416	21	83	45	•	1,131	680	11	2,092	928	133
Precision Mechanisms	12,730	5,861	1,552	996	485	151	451	227	63	254	113	32	321	199	12	•	•	•	435	160	44	1,908	877	244
Ordnance, Shipbuilding, Railroads	17,318	9,751	2,718	1,098	592	203	601	328	55	557	278	67	185	85	•	62	24	14	525	297	57	1,699	833	187
Forge Shops, Foundries, Misc.	37,368	17,452	4,851	2,482	1,430	463	898	426	75	926	562	87	848	492	59	106	80	•	1,831	700	299	5,154	2,237	530
TOTAL	360,566	164,299	51,419	28,574	14,478	4,924	12,049	5,642	1,497	14,732	7,385	1,933	12,200	5,716	1,086	2,484	1,126	397	17,178	7,543	2,349	41,611	18,749	4,658
BY GEOGRAPHIC AREA																								
Boston	25,859	12,333	4,977	1,940	1,120	406	882	423	179	795	486	99	480	251	54	28	22	•	1,033	517	128	3,803	1,834	493
Bridgeport – Hartford	23,736	11,443	4,587	1,424	679	405	903	408	163	1,154	420	262	900	397	50	351	91	35	727	365	142	2,826	1,470	443
New York – Newark	30,430	14,896	3,710	2,177	1,362	237	1,051	521	147	1,249	769	110	997	514	132	752	360	207	1,450	748	147	4,642	1,905	422
Buffalo – Syracuse	13,995	6,880	2,162	1,194	547	276	396	206	56	481	229	113	449	146	103	146	64	35	938	414	143	1,497	784	191
Philadelphia – Camden	15,767	7,066	2,552	908	407	207	525	241	56	419	200	45	249	106	22	54	•	10	754	323	154	2,151	942	262
Pittsburgh – Wheeling	9,869	4,635	1,396	579	363	111	257	157	30	214	116	54	99	51	•	22	17	•	464	191	54	1,550	766	115
Baltimore	5,051	2,404	1,000	382	192	58	181	72	41	155	63	44	66	35	•	11	•	•	295	97	85	450	210	81
Richmond	5,527	2,843	754	314	168	57	184	79	•	110	51	23	65	22	21	•	•	•	152	62	32	552	239	79
Atlanta – New Orleans	6,156	3,217	522	337	186	20	204	67	35	169	117	18	84	52	10	32	22	•	194	104	12	466	215	47
Cleveland	21,544	9,883	2,262	2,297	1,147	259	709	417	81	1,175	511	124	1,002	535	61	107	53	•	1,046	478	139	2,024	907	166
Toledo	6,259	2,586	775	424	210	57	209	78	10	340	156	55	208	77	26	93	30	31	432	180	37	517	196	68
Cincinnati – Louisville	18,281	7,238	4,674	1,073	454	153	486	247	39	535	293	79	522	254	77	85	35	10	982	412	171	2,417	1,126	387
Detroit	44,654	18,866	7,020	4,329	2,161	830	2,049	911	352	2,975	1,438	377	2,807	1,212	237	337	193	10	3,116	1,251	364	5,147	2,396	596
Indianapolis	12,315	5,671	1,746	1,209	679	192	435	207	28	573	307	56	475	209	62	65	23	•	913	309	110	1,544	757	217
Chicago	52,459	24,254	6,686	4,294	2,173	882	1,507	767	165	2,173	1,098	239	2,456	1,214	141	246	140	37	2,285	1,081	323	6,421	2,771	606
Milwaukee	14,610	7,296	2,462	2,118	1,106	446	277	139	48	404	266	51	318	195	52	52	13	13	582	334	103	1,112	529	192
Minneapolis – St. Paul	4,423	2,333	381	328	249	32	90	47	•	153	114	•	54	26	•	16	16	•	153	83	12	408	125	50
St. Louis	6,108	3,239	778	344	201	29	206	106	11	159	111	13	130	91	•	•	•	•	272	162	37	674	300	100
Kansas City – Tulsa	4,157	2,092	387	140	84	20	92	65	•	96	77	•	69	52	•	•	•	•	181	49	27	300	156	30
Dallas – Houston	6,482	2,141	711	362	86	26	189	61	10	305	119	23	96	28	13	•	•	•	238	39	31	403	181	35
Denver	3,511	1,829	445	289	189	12	166	85	•	170	78	28	66	33	•	•	•	•	90	45	10	248	145	•
Seattle – Portland	2,559	1,474	356	119	53	25	64	37	•	52	25	•	41	26	•	•	•	•	62	33	15	140	62	16
San Francisco	4,455	2,063	602	301	111	101	108	41	12	124	57	48	34	14	•	•	•	•	108	53	20	393	161	32
Los Angeles	22,351	8,145	554	1,233	551	83	879	260	17	752	284	50	533	176	•	52	16	•	713	213	53	1,926	572	21
TOTAL	360,566	164,299	51,419	28,574	14,478	4,924	12,049	5,642	1,497	14,732	7,385	1,933	12,200	5,716	1,086	2,484	1,126	397	17,178	7,543	2,349	41,611	18,749	4,658

	Total Units	10 Yrs & Over	Over 20 Yrs
Tool and cutter	67,282	61%	17%
Bench, floorstand, & snag	103,632	64	14
Jig grinders	1,957	43	7
Contour grinders	3,592	48	6
Abrasive belt	21,717	41	4
Other (except thread grinders)	19,874	54	23
Total	360,566	60	14

* – Less than 10

DISK, HORIZONTAL & VERTICAL			TOOL & CUTTER (INCL. DRILL)			BENCH, FLOORSTAND, & SNAG			JIG GRINDERS			CONTOUR GRINDERS			ABRASIVE BELT (NOT POLISHING)			OTHER (EXCEPT THREAD-GRINDERS)			
TOTAL	10-20 YEARS	OVER 20 YR	TOTAL	10-20 YEARS	OVER 20 YR	TOTAL	10-20 YEARS	OVER 20 YR	TOTAL	10-20 YEARS	OVER 20 YR	TOTAL	10-20 YEARS	OVER 20 YR	TOTAL	10-20 YEARS	OVER 20 YR	TOTAL	10-20 YEARS	OVER 20 YR	
																					BY INDUSTRY
330	134	133	1,645	759	320	3,775	2,179	864	*	*	*	30	*	*	425	202	30	400	79	193	Farm Machinery
321	152	66	3,089	1,382	433	5,357	2,596	1,089	21	*	*	23	12	*	1,136	317	64	465	119	60	Const., Mining, Mat. Hdlg.
864	379	174	10,548	4,080	3,279	8,439	4,131	1,434	429	84	*	758	309	37	1,584	646	61	1,978	945	272	Metalworking Machinery
530	294	97	3,124	1,064	981	5,313	2,821	965	36	22	*	73	13	*	1,330	648	42	298	98	82	Special-Industry Machinery
1,200	525	252	6,380	3,089	1,197	6,019	3,288	872	42	21	*	426	237	33	1,014	388	83	5,247	1,793	1,382	General Industrial Equipment
3,063	1,214	415	8,722	4,064	1,122	23,644	11,281	2,806	411	110	84	532	188	102	4,821	1,765	145	3,699	722	1,359	Fabricated Metal Products
686	318	163	1,600	774	254	6,098	3,110	1,218	48	16	*	137	54	*	1,132	322	94	296	79	43	Office and Service Machines
692	248	210	3,977	1,864	692	5,747	2,279	919	108	39	*	142	59	*	1,370	468	66	565	191	79	Electrical Equipment
277	130	30	1,115	577	142	1,211	686	184	12	*	*	27	13	*	197	94	*	95	36	15	Household Appliances
251	71	37	1,472	472	122	2,769	878	146	72	18	*	107	52	*	1,302	495	23	281	188	*	Communications Equipment
927	296	162	8,630	2,753	2,000	3,505	1,285	686	62	11	*	336	46	22	485	123	28	2,954	596	366	Motor Vehicles and Parts
400	246	*	1,072	459	*	2,286	1,403	20	20	*	*	87	56	*	564	180	*	170	109	*	Complete Aircraft
1,553	742	23	4,338	2,204	90	6,185	3,314	146	118	57	*	291	40	*	1,900	596	38	645	312	*	Aircraft Engines, Props, Parts
454	235	63	1,939	864	201	3,829	1,839	320	64	29	*	72	42	*	1,368	715	57	642	86	357	Precision Mechanisms
337	162	87	3,688	2,032	564	6,944	4,223	1,332	354	280	18	44	17	*	337	149	11	887	448	114	Ordnance, Shipbuilding, Railroads
1,799	802	436	5,963	2,426	788	12,570	6,460	1,873	159	16	14	507	376	*	2,772	982	135	1,353	463	175	Forge Shops, Foundries, Misc.
13,684	5,858	2356	67,282	29,443	11,624	103,632	51,773	14,854	1,957	799	132	3,592	1,523	213	21,717	8,090	881	19,874	6,264	4,515	TOTAL
																					BY GEOGRAPHIC AREA
699	394	135	4,741	2,389	702	7,980	3,924	1,534	80	33	*	199	81	13	1,480	698	44	1,731	161	1,182	Boston
969	601	94	3,513	1,828	718	6,621	3,941	1,259	112	53	*	122	43	*	910	295	83	3,204	852	922	Bridgeport – Hartford
1,097	379	177	4,527	2,338	560	8,036	4,176	860	98	29	*	509	398	*	2,334	937	89	1,511	459	617	New York – Newark
706	290	207	2,558	1,240	330	3,776	2,024	570	29	14	*	104	58	*	1,040	437	42	681	240	90	Buffalo – Syracuse
697	225	191	2,816	1,283	491	4,933	2,585	710	95	13	19	98	37	*	975	353	58	1,093	344	325	Philadelphia – Camden
548	261	141	1,933	923	256	2,958	1,277	560	90	60	10	137	72	*	562	194	21	456	187	34	Pittsburgh – Wheeling
117	38	26	1,112	482	192	1,804	1,023	422	16	*	*	22	*	*	214	108	19	226	76	30	Baltimore
132	49	28	944	425	195	2,223	1,228	260	294	242	18	44	29	*	309	130	20	199	119	12	Richmond
249	88	10	961	453	189	2,880	1,647	252	19	*	*	32	21	*	510	206	*	79	33	*	Atlanta – New Orleans
557	252	90	4,793	2,009	477	5,337	2,630	721	70	19	11	273	66	65	735	327	15	1,419	531	51	Cleveland
234	72	31	1,151	376	175	1,390	625	165	19	*	*	210	*	*	277	88	*	755	491	112	Toledo
575	182	120	5,175	1,445	2,473	4,845	2,364	956	110	20	*	124	27	17	860	260	108	492	119	80	Cincinnati – Louisville
1,247	416	282	9,286	3,735	2,036	7,662	3,143	1,331	300	49	20	381	159	27	1,376	578	90	3,143	1,024	468	Detroit
466	258	79	2,502	1,168	379	2,750	1,362	517	36	14	*	114	46	22	376	191	*	857	141	77	Indianapolis
1,998	890	341	9,259	3,972	1,412	14,877	7,445	2,048	237	127	*	587	246	40	4,164	1,579	177	1,995	701	275	Chicago
686	371	93	2,432	1,193	436	5,326	2,636	858	28	12	*	177	52	12	753	267	37	353	93	121	Milwaukee
120	30	25	757	422	78	1,841	1,022	156	14	*	*	26	*	*	317	164	*	146	27	15	Minneapolis – St. Paul
569	300	191	1,015	492	116	2,060	1,130	259	14	*	*	73	32	*	478	238	*	115	59	18	St. Louis
181	110	10	912	508	70	1,519	761	124	144	*	16	49	24	*	294	125	*	171	77	*	Kansas City – Tulsa
249	61	15	1,247	532	72	2,274	733	464	56	*	*	55	20	*	636	110	11	345	164	*	Dallas – Houston
97	46	10	647	381	32	1,382	648	318	13	*	*	18	*	*	181	84	*	136	85	15	Denver
51	20	18	405	196	61	1,326	891	146	*	*	*	14	*	*	183	96	26	96	35	36	Seattle – Portland
92	59	23	896	320	131	1,870	1,058	206	16	*	*	*	*	*	327	104	*	188	81	21	San Francisco
1,348	466	19	3,701	1,333	123	8,012	3,500	158	61	*	*	220	89	*	2,398	521	11	523	164	*	Los Angeles
13,684	5,858	2,366	67,282	29,443	11,624	103,632	51,773	14,854	1,957	799	132	3,592	1,523	213	21,717	8,090	881	19,874	6,264	4,515	TOTAL

Lathes

	Total Units	10 Yrs & Over	Over 20 Yrs
Bench, floor, light-duty	57,577	61%	16%
Engine, heavy-duty: Standard	73,107	73	29
Engine, heavy-duty: Toolroom	39,382	59	15
Engine, heavy-duty: Mfg & Gap	6,897	65	26
Engine, heavy-duty: Tracer	3,681	19	3
Turret, ram-type	47,665	66	13
Turret, saddle-type	26,739	70	14

• – Less than 10

	TOTAL LATHES			BENCH, FLOOR LIGHT-DUTY (INCL TURRET ATTACHMENT)			ENGINE, HEAVY-DUTY — STANDARD			TOOLROOM			MANUFACTURING & GAP			TRACER			TURRET LATHES, RAM TYPE		
	TOTAL	10-20 YEARS	OVER 20 YR	TOTAL	10-20 YEARS	OVER 20 YR	TOTAL	10-20 YEARS	OVER 20 YR	TOTAL	10-20 YEARS	OVER 20 YR	TOTAL	10-20 YEARS	OVER 20 YR	TOTAL	10-20 YEARS	OVER 20 YR	TOTAL	10-20 YEARS	OVER 20 YR
BY INDUSTRY																					
Farm Machinery	8,468	3,903	2,338	649	363	161	1,540	661	543	607	264	135	173	102	24	41	•	•	1,488	790	315
Const., Mining, Mat. Hdlg.	14,105	6,948	2,746	795	412	161	4,018	1,893	1,225	872	392	114	401	223	48	223	49	•	2,220	1,335	250
Metalworking Machinery	29,257	14,004	5,475	4,571	2,171	715	7,242	3,553	1,983	4,903	2,240	705	880	251	223	488	80	•	3,596	1,904	372
Special-Industry Machinery	17,856	8,570	5,184	2,926	1,247	1,084	6,512	2,790	2,249	1,618	758	438	292	104	81	225	38	•	2,890	1,726	436
General Industrial Equipment	33,123	16,111	5,930	3,305	1,630	561	6,438	3,017	1,962	2,528	1,164	356	975	452	284	585	81	•	5,951	3,363	720
Fabricated Metal Products	71,839	32,937	12,950	9,864	4,580	1,481	11,332	4,717	3,804	9,300	4,211	1,691	1,070	307	453	343	50	24	8,680	4,818	1,234
Office and Service Machines	14,103	5,990	4,019	2,556	969	719	2,306	987	822	1,079	457	212	124	33	68	31	•	•	1,711	849	333
Electrical Equipment	25,309	11,242	4,181	5,723	2,276	602	5,275	2,130	1,537	2,188	872	238	250	163	27	104	38	•	3,372	1,750	373
Household Appliances	4,587	2,429	700	926	391	152	813	448	102	401	217	23	165	104	•	12	•	•	627	424	129
Communications Equipment	11,499	4,306	766	4,398	1,442	311	1,783	685	133	1,392	568	84	107	38	•	61	•	•	818	253	39
Motor Vehicles and Parts	18,787	6,357	3,685	972	517	151	3,568	1,259	1,113	993	389	203	732	192	247	154	•	•	1,144	641	203
Complete Aircraft	3,031	1,280	69	500	227	15	910	488	15	533	153	11	71	15	•	68	•	•	684	298	23
Aircraft Engines, Props, Parts	23,337	11,125	780	3,847	1,917	65	4,641	2,159	312	2,558	1,023	101	636	189	21	580	56	•	5,475	2,703	102
Precision Mechanisms	21,635	9,533	4,970	6,517	3,117	1,591	2,408	1,118	385	2,402	921	346	210	79	14	144	26	•	2,826	1,294	541
Ordnance, Shipbuilding, Railroads	17,759	9,171	3,285	2,974	1,509	570	5,172	2,629	1,131	2,762	1,421	609	206	52	29	283	119	50	1,739	927	289
Forge Shops, Foundries, Misc.	34,463	15,851	7,425	7,274	3,176	917	9,105	3,723	3,438	5,168	2,303	577	835	353	285	337	51	•	4,524	2,250	670
TOTAL	349,068	158,055	64,503	57,577	25,944	9,256	73,107	32,257	20,754	39,382	17,333	5,842	6,897	2,657	1,808	3,681	613	180	47,665	25,325	6,037
BY GEOGRAPHIC AREA																					
Boston	32,920	15,612	7,376	7,615	3,190	1,871	6,867	2,905	2,407	3,148	1,515	553	327	119	92	368	61	29	3,874	2,335	396
Bridgeport – Hartford	21,654	8,770	5,402	3,690	1,478	869	3,102	1,297	1,036	2,476	1,062	513	330	139	47	170	26	•	2,133	949	326
New York – Newark	32,705	15,449	5,081	7,559	3,581	1,043	7,119	3,237	1,892	4,106	1,960	413	356	115	97	393	53	•	4,333	2,543	404
Buffalo – Syracuse	17,530	8,081	3,955	2,579	1,099	512	3,451	1,497	1,166	1,531	605	390	370	122	120	84	31	•	2,842	1,477	483
Philadelphia – Camden	15,090	6,946	3,365	2,473	1,247	376	4,343	1,841	1,443	1,718	863	293	191	84	37	146	•	•	2,248	999	372
Pittsburgh – Wheeling	9,206	4,669	2,084	913	462	145	3,186	1,353	1,112	1,408	880	142	83	29	22	95	21	•	1,263	721	213
Baltimore	5,603	2,448	1,163	1,247	586	244	1,369	515	293	622	284	144	76	27	39	21	•	•	816	346	58
Richmond	6,163	2,776	1,121	1,643	580	232	1,693	751	439	820	442	142	58	26	16	200	90	45	688	403	91
Atlanta – New Orleans	6,891	3,187	1,522	1,041	602	121	2,751	1,206	917	948	368	100	99	81	•	50	•	•	967	493	158
Cleveland	21,612	9,787	3,897	2,332	1,105	410	2,989	1,452	997	2,131	873	398	246	79	79	280	33	•	4,090	1,949	525
Toledo	4,888	2,374	792	407	223	57	811	389	208	723	286	120	359	199	98	91	10	•	638	336	82
Cincinnati – Louisville	15,724	7,504	3,391	2,149	902	492	3,965	1,928	1,030	1,282	560	279	229	84	49	117	30	•	2,553	1,598	345
Detroit	28,241	13,273	4,812	3,149	1,636	361	4,793	2,257	1,186	3,815	1,759	578	744	362	137	275	52	•	2,730	1,641	317
Indianapolis	10,734	5,463	1,693	1,342	784	137	2,196	1,058	530	954	522	146	173	44	86	94	•	•	1,383	918	144
Chicago	52,033	22,540	9,092	8,508	3,679	1,252	8,388	3,547	2,413	5,359	2,200	701	1,411	562	300	452	69	•	6,852	3,686	1,129
Milwaukee	15,029	7,009	3,378	2,179	1,040	315	2,400	1,178	742	1,634	756	309	648	150	334	131	35	•	2,322	1,331	448
Minneapolis – St. Paul	4,354	1,839	820	488	247	98	1,121	469	401	646	281	66	172	16	34	33	•	•	780	345	86
St. Louis	5,980	3,253	1,296	1,008	616	169	1,750	824	584	916	469	131	129	51	71	68	21	•	626	392	70
Kansas City – Tulsa	4,089	2,305	539	516	265	95	999	377	267	510	192	42	144	86	47	32	10	•	528	357	16
Dallas – Houston	5,915	2,186	535	750	306	36	1,685	685	280	664	205	78	164	68	•	101	•	•	1,009	423	34
Denver	3,730	2,128	328	691	421	62	996	536	187	470	226	•	25	•	20	25	•	•	595	405	•
Seattle – Portland	1,996	1,021	442	306	177	45	722	312	237	292	175	74	56	30	16	25	•	•	242	117	46
San Francisco	4,743	2,153	1,010	610	181	150	1,592	756	437	533	249	111	74	25	•	44	•	•	518	229	103
Los Angeles	21,659	7,874	1,489	4,383	1,537	172	4,838	1,987	562	2,676	681	110	441	157	51	386	43	•	3,625	1,431	186
TOTAL	349,068	158,055	64,503	57,577	25,944	9,256	73,107	32,257	20,754	39,382	17,333	5,842	6,897	2,657	1,808	3,681	613	180	47,665	25,325	6,037

	Total Units	10 Yrs & Over	Over 20 Yrs
Auto chuck & between centers	14,819	58%	17%
Auto chuck (multi-spindle)	8,546	55	16
Auto screw machines (sing.sp.)	43,224	60	19
Auto bar machines (multi-sp.)	18,280	62	11
Other	9,151	64	31
Total	349,068	64	18

• – Less than 10

TURRET LATHES, SADDLE TYPE			AUTOMATIC CHUCKING & BETWEEN CENTERS (SINGLE SPINDLE)			AUTOMATIC CHUCKING (MULTI-SPINDLE)			AUTOMATIC SCREW MACHINES (SINGLE SPINDLE)			AUTOMATIC BAR MACHINES (MULTI-SPINDLE)			OTHER (EXCEPT SPINNING LATHES)			
TOTAL	10-20 YEARS	OVER 20 YR	TOTAL	10-20 YEARS	OVER 20 YR	TOTAL	10-20 YEARS	OVER 20 YR	TOTAL	10-20 YEARS	OVER 20 YR	TOTAL	10-20 YEARS	OVER 20 YR	TOTAL	10-20 YEARS	OVER 20 YR	
																		BY INDUSTRY
1,116	559	315	1,350	546	401	436	214	127	348	99	109	442	265	73	358	93	135	Farm Machinery
2,772	1,489	427	1,587	636	369	362	126	32	234	66	27	452	172	48	169	55	43	Const., Mining, Mat. Hdlg.
3,368	1,883	444	800	237	64	142	88	10	1,924	896	370	708	428	81	1,021	273	504	Metalworking Machinery
1,569	1,070	168	515	213	283	161	44	91	706	228	218	197	116	45	245	56	171	Special-Industry Machinery
4,880	2,285	677	2,242	986	274	1,334	553	173	3,809	1,723	770	1,249	580	51	685	277	97	General Industrial Equipment
3,937	2,283	594	808	340	18	1,675	782	289	13,785	5,354	1,794	10,025	5,144	1,022	1,132	351	546	Fabricated Metal Products
732	504	99	247	48	95	290	136	61	3,573	1,356	1,229	1,285	597	361	109	54	20	Office and Service Machines
1,093	682	92	1,617	733	287	434	188	70	3,255	1,701	502	752	373	74	1,266	416	376	Electrical Equipment
30	26	•	97	29	41	133	71	12	893	462	182	285	201	•	125	55	51	Household Appliances
392	198	44	65	10	16	13	•	•	1,855	841	69	168	55	26	447	204	39	Communications Equipment
745	336	179	2,935	951	577	2,654	631	421	2,634	863	280	942	347	84	1,322	222	227	Motor Vehicles and Parts
118	44	•	17	•	•	•	•	•	100	38	•	•	•	•	33	11	•	Complete Aircraft
2,348	1,465	43	876	364	17	330	206	17	1,213	662	•	474	332	81	349	49	11	Aircraft Engines, Props, Parts
943	409	155	247	28	•	77	35	14	5,244	2,223	1,805	292	132	•	325	151	110	Precision Mechanisms
1,430	716	172	947	638	62	145	92	21	1,149	568	150	183	98	15	709	422	187	Ordnance, Shipbuilding, Railroads
2,136	1,073	415	666	232	100	358	178	36	2,502	931	574	762	394	114	796	387	282	Forge Shops, Foundries, Misc.
26,739	14,942	3,828	14,819	5,994	2,531	8,546	3,349	1,377	43,224	18,011	8,090	18,280	9,154	2,081	9,151	3,076	2,799	TOTAL
																		BY GEOGRAPHIC AREA
1,785	975	221	961	418	317	299	161	47	5,355	2,884	975	1,365	681	91	956	388	377	Boston
705	400	149	293	145	73	766	347	165	6,518	2,585	2,046	1,101	304	62	282	48	112	Bridgeport – Hartford
1,855	1,168	245	798	384	90	485	257	51	3,742	1,300	459	893	490	45	1,066	368	342	New York – Newark
1,261	742	227	993	497	198	315	158	28	2,629	1,250	589	1,080	494	120	387	109	122	Buffalo – Syracuse
1,194	536	252	481	131	46	171	54	66	1,409	684	182	1,043	450	223	273	79	75	Philadelphia – Camden
1,100	695	161	206	95	•	42	33	•	259	104	81	267	153	29	376	113	166	Pittsburgh – Wheeling
510	289	109	135	41	43	•	•	•	482	223	92	110	37	43	211	96	96	Baltimore
293	155	38	111	60	17	35	•	35	480	191	44	75	53	•	58	25	20	Richmond
448	208	59	156	84	16	56	26	•	224	72	95	78	46	•	73	•	40	Atlanta – New Orleans
2,578	1,444	348	1,122	347	70	518	221	82	2,246	679	384	2,358	1,581	146	722	124	458	Cleveland
426	290	48	250	100	21	252	84	19	411	149	50	313	178	77	207	121	12	Toledo
1,292	895	73	429	172	44	534	134	147	2,281	831	665	622	257	142	271	112	114	Cincinnati – Louisville
1,686	1,040	226	1,770	540	299	2,197	650	422	3,014	1,436	402	2,923	1,628	625	1,135	272	250	Detroit
700	467	68	819	335	189	565	164	63	1,259	573	182	730	374	77	519	217	68	Indianapolis
4,136	2,132	763	3,279	1,362	647	1,074	438	68	7,840	2,916	1,222	3,276	1,497	185	1,477	542	486	Chicago
1,887	1,008	366	1,045	335	358	555	250	133	1,337	587	215	594	268	182	385	71	56	Milwaukee
489	292	52	97	21	•	120	85	14	294	80	65	78	61	•	44	14	•	Minneapolis – St. Paul
320	180	84	122	86	•	93	73	•	456	243	84	368	248	76	113	58	28	St. Louis
345	240	41	603	539	10	44	28	•	194	103	•	113	79	•	61	29	•	Kansas City – Tulsa
919	320	101	181	40	•	177	77	10	119	44	•	131	38	•	95	57	•	Dallas – Houston
385	252	29	51	29	•	35	11	•	343	183	•	71	43	•	23	10	•	Denver
186	129	•	•	•	•	•	•	•	68	36	10	30	12	10	53	30	•	Seattle – Portland
473	258	68	100	38	11	31	17	•	486	251	98	163	93	14	119	56	13	San Francisco
1,748	808	97	810	195	58	189	77	•	1,709	784	132	489	178	•	325	144	31	Los Angeles
26,739	14,942	3,828	14,819	5,994	2,531	8,546	3,349	1,377	43,224	18,011	8,090	18,280	9,154	2,081	9,151	3,076	2,799	TOTAL

Milling Machines

	Total Units	10 Yrs & Over	Over 20 Yrs
Bench type	7,892	57%	15%
Hand	19,668	71	23
Knee-type, horizontal	61,458	67	21
Knee-type, vertical	36,130	49	8
Automatic & manufacturing	11,549	68	15
Ram type, swivel head	5,734	34	5

* – Less than 10

	TOTAL MILLING MACHINES			BENCH TYPE			HAND			KNEE-TYPE, HORIZONTAL (PLAIN & UNIVERSAL)			KNEE-TYPE, VERTICAL			KNEE-TYPE, AUTOMATIC AND MANUFACTURING		
	TOTAL	10-20 YEARS	OVER 20 YR	TOTAL	10-20 YEARS	OVER 20 YR	TOTAL	10-20 YEARS	OVER 20 YR	TOTAL	10-20 YEARS	OVER 20 YR	TOTAL	10-20 YEARS	OVER 20 YR	TOTAL	10-20 YEARS	OVER 20 YR
BY INDUSTRY																		
Farm Machinery	3,544	1,639	890	60	42	*	363	168	89	1,707	781	499	468	212	75	349	196	33
Const., Mining, Mat. Hdlg.	5,230	2,106	1,241	100	32	20	316	137	95	2,369	1,079	446	848	328	127	184	133	14
Metalworking Machinery	23,848	10,383	3,918	450	161	42	1,757	816	307	9,195	4,405	2,156	6,189	2,508	506	928	587	59
Special-Industry Machinery	10,715	4,831	2,760	323	127	80	824	341	352	4,817	2,162	1,364	2,249	1,071	298	517	380	52
General Industrial Equipment	11,226	5,534	2,031	353	145	34	1,349	644	344	4,449	2,203	956	2,063	1,004	199	785	425	141
Fabricated Metal Products	23,997	10,895	4,663	1,975	952	182	4,478	2,195	964	8,326	3,842	2,121	4,286	1,651	422	1,741	976	163
Office and Service Machines	8,117	3,787	2,083	226	88	89	1,349	651	387	2,724	1,219	896	1,027	485	130	802	352	222
Electrical Equipment	10,532	3,995	1,758	870	286	70	1,433	556	348	3,573	1,443	825	2,494	834	211	357	106	63
Household Appliances	3,789	2,042	756	161	75	43	342	199	65	819	448	98	394	205	32	865	575	167
Communications Equipment	6,942	2,334	347	475	230	23	543	311	28	1,954	541	210	1,896	422	41	579	298	17
Motor Vehicles and Parts	7,377	2,525	1,647	116	66	*	635	280	227	1,853	673	530	1,011	379	132	1,055	385	250
Complete Aircraft	3,648	1,552	21	58	29	*	100	50	*	1,813	827	15	580	259	*	100	19	*
Aircraft Engines, Props, Parts	15,657	6,990	570	271	134	*	1,681	1,050	31	5,437	2,725	238	3,709	1,607	61	501	265	14
Precision Mechanisms	8,975	3,560	1,830	917	300	269	1,297	449	443	2,576	1,224	530	1,857	685	101	655	347	116
Ordnance, Shipbuilding, Railroads	13,097	6,473	3,005	477	252	81	1,072	670	318	3,521	1,904	463	2,123	1,066	244	1,032	456	229
Forge Shops, Foundries, Misc.	19,998	8,486	3,632	1,060	425	212	2,129	993	551	6,325	2,987	1,490	4,936	1,912	426	1,099	573	237
TOTAL	176,684	77,132	31,152	7,892	3,344	1,161	19,668	9,510	4,549	61,458	28,463	12,837	36,130	14,628	3,005	11,549	6,073	1,779
BY GEOGRAPHIC AREA																		
Boston	16,161	7,436	3,517	989	380	258	2,100	1,156	386	5,534	2,325	1,853	3,261	1,393	345	916	533	126
Bridgeport – Hartford	15,397	6,782	4,451	684	311	106	2,136	895	800	3,653	1,846	725	2,203	970	237	1,986	1,006	424
New York – Newark	18,773	7,934	2,731	994	366	117	1,442	636	245	6,865	3,102	1,438	4,360	1,864	214	731	397	45
Buffalo – Syracuse	8,017	3,548	1,825	325	146	51	1,167	462	475	2,981	1,366	750	1,604	725	177	632	295	179
Philadelphia – Camden	7,652	3,342	1,703	337	152	80	824	340	254	3,213	1,443	850	1,584	650	258	345	187	63
Pittsburgh – Wheeling	4,534	2,234	762	189	114	28	268	143	67	1,783	935	345	1,296	587	111	101	85	*
Baltimore	3,003	1,380	507	232	126	42	185	94	20	1,273	656	205	664	224	130	93	58	*
Richmond	2,669	1,152	267	248	136	14	120	56	29	1,053	458	147	545	162	34	111	62	*
Atlanta – New Orleans	2,421	1,136	435	152	49	34	187	82	53	1,120	601	233	401	173	10	143	127	11
Cleveland	10,352	4,597	1,746	319	161	23	1,489	897	209	3,559	1,679	688	1,916	776	154	496	256	38
Toledo	2,342	1,007	362	73	35	*	260	133	70	717	358	135	451	179	59	251	154	37
Cincinnati – Louisville	7,962	3,471	1,933	299	95	163	1,034	442	350	2,923	1,371	825	1,557	677	158	648	307	115
Detroit	15,269	6,986	2,503	315	167	50	1,816	1,054	394	4,481	2,176	759	3,241	1,534	289	1,550	747	328
Indianapolis	4,706	2,045	887	163	101	14	468	187	173	1,358	665	329	985	399	81	418	198	61
Chicago	24,297	10,681	4,163	1,000	398	100	2,822	1,247	555	8,363	3,828	1,758	4,618	1,952	458	1,796	982	152
Milwaukee	6,028	3,072	1,377	198	117	17	842	393	192	2,495	1,223	752	932	466	83	346	200	54
Minneapolis – St. Paul	1,976	751	310	54	29	16	156	85	40	769	373	141	573	121	21	103	39	25
St. Louis	2,828	1,652	447	81	60	*	422	285	91	1,060	606	203	564	347	43	256	122	95
Kansas City – Tulsa	1,834	723	105	69	47	*	98	45	11	700	334	48	563	128	14	45	35	*
Dallas – Houston	2,739	859	269	139	26	*	223	90	*	1,219	394	162	591	189	41	68	37	*
Denver	1,548	890	78	103	66	*	113	70	*	617	369	33	294	158	22	69	46	*
Seattle – Portland	872	408	139	36	13	13	29	15	*	385	156	65	79	28	*	59	32	12
San Francisco	2,434	687	289	99	63	*	248	150	49	797	267	152	577	112	32	45	19	*
Los Angeles	12,870	4,359	426	794	186	*	1,219	553	69	4,540	1,932	246	3,271	814	31	341	149	*
TOTAL	176,684	77,132	31,152	7,892	3,344	1,161	19,668	9,510	4,549	61,458	28,463	12,837	36,130	14,628	3,005	11,549	6,073	1,779

Milling Machines

	Total Units	10 Yrs & Over	Over 20 Yrs
Bed (Lincoln) type	9,639	67%	19%
Planer type	3,461	69	30
Profilers, diesinkers, etc.	12,033	51	14
Other	9,120	65	33
Total	176,684	61	18

• – Less than 10

RAM TYPE, SWIVEL HEAD			BED (LINCOLN) TYPE			PLANER TYPE (INCL SKIN & SPAR)			PROFILERS, DUPLICATORS, DIESINKERS, ENGRAVERS			OTHER (EXCEPT THREAD MILLING)			
TOTAL	10-20 YEARS	OVER 20 YR	TOTAL	10-20 YEARS	OVER 20 YR	TOTAL	10-20 YEARS	OVER 20 YR	TOTAL	10-20 YEARS	OVER 20 YR	TOTAL	10-20 YEARS	OVER 20 YR	BY INDUSTRY
45	20	10	161	60	64	106	18	54	52	31	•	233	111	57	Farm Machinery
72	30	•	719	203	269	251	70	127	52	17	•	319	77	127	Const., Mining, Mat. Hdlg.
732	175	10	1,000	535	72	499	181	104	1,672	606	159	1,426	409	503	Metalworking Machinery
308	111	10	563	296	147	354	91	175	426	146	142	334	106	140	Special-Industry Machinery
308	117	11	748	403	137	359	216	98	276	90	34	536	287	77	General Industrial Equipment
676	232	47	662	320	179	460	233	149	731	226	220	662	268	216	Fabricated Metal Products
288	77	17	728	528	29	83	•	61	821	360	217	69	18	35	Office and Service Machines
641	203	56	244	149	30	175	128	23	327	152	71	418	138	61	Electrical Equipment
129	47	•	257	196	•	190	87	25	135	61	15	497	149	299	Household Appliances
344	108	•	399	190	•	28	16	•	553	202	•	171	16	•	Communications Equipment
104	17	•	610	247	141	95	12	20	572	157	74	1,326	309	260	Motor Vehicles and Parts
63	30	•	125	61	•	226	53	•	500	202	•	75	22	•	Complete Aircraft
681	198	•	622	294	28	198	83	11	2,151	480	155	406	154	24	Aircraft Engines, Props, Parts
354	120	•	261	16	•	29	•	•	446	212	39	583	202	317	Precision Mechanisms
85	21	36	1,945	840	651	147	65	52	1,039	696	75	1,656	503	856	Ordnance, Shipbuilding, Railroads
904	162	47	595	319	76	261	82	128	2,280	873	408	409	160	57	Forge Shops, Foundries, Misc.
5,734	1,668	270	9,639	4,657	1,836	3,461	1,349	1,044	12,033	4,511	1,633	9,120	2,929	3,038	TOTAL
															BY GEOGRAPHIC AREA
626	211	45	983	593	110	361	161	120	1,075	561	213	316	123	61	Boston
278	105	28	1,723	849	673	110	46	26	718	384	147	1,906	370	1,285	Bridgeport – Hartford
767	222	10	942	315	86	238	78	94	1,625	624	158	809	330	324	New York – Newark
115	32	•	220	130	37	200	138	17	463	185	98	310	69	38	Buffalo – Syracuse
344	133	47	174	96	15	118	59	35	369	171	55	344	111	46	Philadelphia – Camden
176	54	•	225	105	73	173	59	64	236	121	40	87	31	23	Pittsburgh – Wheeling
38	15	•	147	77	29	33	13	12	200	68	22	138	49	35	Baltimore
111	47	•	129	79	11	50	•	28	186	66	•	116	80	•	Richmond
94	16	32	66	37	14	76	10	44	139	30	•	43	11	•	Atlanta – New Orleans
221	83	•	474	217	57	176	56	68	778	294	38	924	178	471	Cleveland
68	32	•	53	21	•	61	10	28	226	15	•	182	70	21	Toledo
163	36	•	255	138	49	156	39	66	645	237	155	282	129	45	Cincinnati – Louisville
581	112	11	739	409	110	214	119	28	1,013	306	249	1,319	362	285	Detroit
90	30	•	351	159	23	57	15	16	475	167	68	341	124	46	Indianapolis
672	241	25	2,040	884	423	751	303	228	1,217	493	249	1,018	353	215	Chicago
113	47	16	366	236	76	170	83	65	263	124	49	303	183	73	Milwaukee
52	11	•	40	24	•	41	•	34	125	34	•	63	30	11	Minneapolis – St. Paul
55	28	•	99	47	•	46	19	•	128	62	•	117	76	•	St. Louis
36	•	•	99	39	•	58	•	16	117	60	•	49	22	•	Kansas City – Tulsa
113	20	•	61	15	•	62	19	•	159	41	•	104	28	30	Dallas – Houston
72	33	•	87	51	•	44	27	•	99	43	•	50	27	•	Denver
29	•	•	40	27	•	57	15	12	59	40	•	99	80	17	Seattle – Portland
53	18	•	85	•	14	•	•	•	489	29	31	36	20	•	San Francisco
867	131	•	241	102	•	204	63	20	1,229	356	39	164	73	•	Los Angeles
5,734	1,668	270	9,639	4,657	1,836	3,461	1,349	1,044	12,033	4,511	1,633	9,120	2,929	3,038	TOTAL

Honing and Lapping Machines

	Total Units	10 Yrs & Over	Over 20 Yrs
Honing, internal	10,318	41%	4%
Honing, external & surface	1,048	38	3
Lapping, surface	4,780	50	10
Lapping, cylindrical	2,645	52	13
Other lapping	1,973	50	11
Total	20,764	45	7

• – Less than 10

	TOTAL HONING & LAPPING MACHINES			INTERNAL HONING (INCL. COMBINATION)			EXTERNAL & SURFACE HONING			SURFACE LAPPING			CYLINDRICAL LAPPING			OTHER LAPPING (INCL. COMBINATION HONE LAP)		
	TOTAL	10-20 YEARS	OVER 20 YR	TOTAL	10-20 YEARS	OVER 20 YR	TOTAL	10-20 YEARS	OVER 20 YR	TOTAL	10-20 YEARS	OVER 20 YR	TOTAL	10-20 YEARS	OVER 20 YR	TOTAL	10-20 YEARS	OVER 20 YR
BY INDUSTRY																		
Farm Machinery	520	248	52	374	186	25	35	•	•	20	18	•	90	38	26	•	•	•
Const., Mining, Mat. Hdlg.	477	211	33	322	141	25	22	•	•	36	•	•	57	36	•	40	24	•
Metalworking Machinery	3,020	1,313	266	1,518	618	63	58	10	•	505	230	67	415	133	61	524	322	73
Special-Industry Machinery	527	229	18	383	162	15	31	29	•	64	13	•	32	15	•	17	10	•
General Industrial Equipment	3,867	1,668	381	1,502	479	100	177	85	•	1,361	757	167	459	188	110	368	159	•
Fabricated Metal Products	1,519	555	25	1,011	405	17	82	40	•	238	52	•	76	39	•	112	19	•
Office and Service Machines	689	293	154	325	135	72	15	•	•	252	102	82	80	38	•	17	10	•
Electrical Equipment	977	264	34	310	79	•	71	19	•	341	92	•	137	19	•	118	55	•
Household Appliances	584	246	89	225	76	•	23	•	•	80	26	35	229	124	43	27	12	•
Communications Equipment	586	66	•	200	16	•	72	25	•	214	•	•	•	•	•	91	20	•
Motor Vehicles and Parts	2,166	433	93	903	176	24	161	17	•	450	113	40	384	118	19	268	•	•
Complete Aircraft	135	22	•	87	13	•	10	•	•	10	•	•	•	•	•	24	•	•
Aircraft Engines, Props, Parts	1,948	724	39	1,174	421	•	95	24	•	286	138	•	218	60	32	175	81	•
Precision Mechanisms	923	328	38	380	129	15	57	15	•	379	128	19	84	44	•	23	12	•
Ordnance, Shipbuilding, Railroads	600	306	54	411	210	17	35	20	•	75	33	18	55	31	•	24	12	•
Forge Shops, Foundries, Misc.	2,226	954	207	1,193	540	37	104	63	•	469	201	21	316	130	27	144	20	116
Total Total	20,764	7,860	1,490	10,318	3,786	430	1,048	373	28	4,780	1,916	467	2,645	1,015	346	1,973	770	219
BY GEOGRAPHIC AREA																		
Boston	1,128	512	93	505	196	20	81	24	•	261	136	35	85	37	•	196	119	25
Bridgeport – Hartford	1,875	818	212	697	189	•	101	31	•	634	383	171	93	44	11	350	171	24
New York – Newark	1,553	730	155	737	347	17	84	41	•	408	196	•	116	65	21	208	81	107
Buffalo – Syracuse	604	282	49	352	154	32	31	27	•	90	40	16	90	44	•	41	17	•
Philadelphia – Camden	664	213	21	361	131	14	23	11	•	214	42	•	42	17	•	24	12	•
Pittsburgh – Wheeling	315	88	•	81	52	•	37	•	•	118	•	•	17	•	•	62	15	•
Baltimore	207	82	26	112	52	17	•	•	•	69	19	•	11	•	•	13	•	•
Richmond	161	46	•	128	35	•	•	•	•	16	•	•	•	•	•	•	•	•
Atlanta – New Orleans	288	63	•	149	39	•	•	•	•	106	•	•	17	10	•	14	•	•
Cleveland	1,004	381	16	541	238	•	35	21	•	161	68	•	139	27	•	128	27	•
Toledo	527	181	37	248	76	•	•	•	•	129	69	•	92	33	21	52	•	•
Cincinnati – Louisville	967	278	175	448	135	57	61	18	•	230	58	98	205	61	17	23	•	•
Detroit	2,945	1,084	231	1,294	416	60	223	98	•	639	262	53	420	142	75	369	166	41
Indianapolis	676	211	19	265	102	•	85	12	•	210	55	•	74	25	•	42	17	•
Chicago	3,342	1,363	215	1,781	706	98	81	35	•	583	250	30	701	343	81	196	29	•
Milwaukee	673	295	55	497	231	46	27	•	•	76	20	•	51	26	•	22	11	•
Minneapolis – St. Paul	169	66	•	97	40	•	15	11	•	39	13	•	18	•	•	•	•	•
St. Louis	517	262	69	281	110	24	37	13	•	136	117	18	52	•	27	31	17	•
Kansas City – Tulsa	155	50	10	99	30	•	•	•	•	17	•	•	10	•	•	21	16	•
Dallas – Houston	235	90	•	175	78	•	12	•	•	42	•	•	•	•	•	•	•	•
Denver	230	83	10	129	63	•	•	•	•	63	15	10	17	•	•	15	•	•
Seattle – Portland	88	41	•	71	30	•	•	•	•	11	10	•	•	•	•	•	•	•
San Francisco	245	52	63	91	22	•	•	•	•	43	•	•	101	24	58	•	•	•
Los Angeles	2,196	589	18	1,179	314	14	83	10	•	485	135	•	300	83	•	149	47	•
Total	20,764	7,860	1,490	10,318	3,786	430	1,048	373	28	4,780	1,916	467	2,645	1,015	346	1,973	770	219

Planers, Shapers

	Total Units	10 Yrs & Over	Over 20 Yrs
Planers, double housing	8,160	90%	55%
Planers, openside & other	4,119	74	39
Total planers	12,279	85	50
Shapers, horizontal	29,227	77	32
Shapers, vertical	6,543	75	32
Total shapers	35,770	77	32

• – Less than 10

	TOTAL PLANERS			DOUBLE HOUSING			OPENSIDE & OTHER			TOTAL SHAPERS			HORIZONTAL			VERTICAL, INCL. SLOTTERS & KEYSEATERS		
	TOTAL	10-20 YEARS	OVER 20 YR	TOTAL	10-20 YEARS	OVER 20 YR	TOTAL	10-20 YEARS	OVER 20 YR	TOTAL	10-20 YEARS	OVER 20 YR	TOTAL	10-20 YEARS	OVER 20 YR	TOTAL	10-20 YEARS	OVER 20 YR
BY INDUSTRY																		
Farm Machinery	236	75	152	133	40	88	103	35	64	724	379	267	392	296	243	132	83	24
Const., Mining, Mat. Hdlg.	564	200	326	392	131	257	172	69	69	1,374	540	534	983	422	335	391	118	199
Metalworking Machinery	2,522	1,025	929	1,792	801	733	730	224	196	4,477	2,128	1,132	3,631	1,724	885	846	404	247
Special Industry Machinery	1,677	489	968	1,221	333	792	456	156	176	1,869	727	864	1,397	534	675	472	193	189
General Industrial Equipment	568	168	360	360	108	240	208	60	120	2,035	814	832	1,362	534	550	673	280	282
Fabricated Metal Products	2,431	761	1,460	1,609	496	1,037	822	265	423	8,681	3,592	3,022	7,777	3,171	2,746	904	421	276
Office and Service Machines	211	50	147	153	37	113	58	13	34	945	397	402	823	347	364	122	50	38
Electrical Equipment	386	103	127	232	74	75	154	29	52	2,475	995	821	1,988	849	676	487	146	145
Household Appliances	90	19	29	53	18	21	37	•	•	400	234	70	335	204	50	65	30	20
Communications Equipment	93	63	21	78	59	19	15	•	•	869	509	126	734	432	117	135	77	•
Motor Vehicles and Parts	367	94	144	191	49	77	176	45	67	1,716	590	528	1,403	489	437	313	101	91
Complete Aircraft	90	55	•	18	14	•	72	41	•	458	276	•	339	220	•	119	56	•
Aircraft Engines, Props, Parts	349	140	78	195	86	48	154	54	30	1,363	755	170	1,152	626	154	211	129	16
Precision Mechanisms	124	49	60	50	•	38	74	42	22	844	458	207	784	413	200	60	45	•
Ordnance, Shipbuilding, Railroads	705	367	232	389	193	142	316	174	90	2,676	1,331	799	1,751	857	551	925	474	248
Forge Shops, Foundries, Misc.	1,866	631	1,078	1,294	395	841	572	236	237	4,864	2,197	1,671	4,176	1,948	1,398	688	249	273
TOTAL	12,279	4,289	6,111	8,160	2,841	4,521	4,119	1,448	1,590	35,770	15,922	11,447	29,227	13,066	9,383	6,543	2,856	2,064
BY GEOGRAPHIC AREA																		
Boston	1,340	481	745	977	328	589	363	153	156	2,399	1,009	955	2,007	855	807	392	154	148
Bridgeport – Hartford	505	101	363	417	71	329	88	30	34	1,528	575	723	1,272	489	576	256	86	147
New York – Newark	818	263	411	558	168	344	260	95	67	3,232	1,478	1,012	2,520	1,180	847	712	298	165
Buffalo – Syracuse	475	166	239	349	134	181	126	32	58	1,591	637	596	1,237	515	468	354	122	128
Philadelphia – Camden	766	218	456	470	111	299	296	107	157	1,984	899	752	1,632	708	658	352	191	94
Pittsburgh – Wheeling	793	368	362	550	266	260	243	102	102	1,879	916	571	1,475	740	424	404	176	147
Baltimore	173	77	56	90	39	36	83	38	20	540	234	147	404	186	100	136	48	47
Richmond	305	133	161	220	79	133	85	54	28	731	403	149	557	300	121	174	103	28
Atlanta – New Orleans	504	180	245	359	163	174	145	17	71	1,216	589	398	899	483	242	317	106	156
Cleveland	843	292	469	547	200	312	296	92	157	2,310	1,065	806	1,905	871	655	405	194	151
Toledo	210	82	71	130	59	46	80	23	25	508	210	135	407	175	101	101	35	34
Cincinnati – Louisville	741	270	291	541	226	224	200	44	67	1,500	583	541	1,148	435	431	352	148	110
Detroit	791	242	316	418	136	180	373	106	136	3,979	1,592	1,036	3,464	1,332	909	515	260	127
Indianapolis	189	90	69	117	64	42	72	26	27	1,119	479	275	930	409	216	189	70	59
Chicago	1,463	528	677	937	323	543	526	205	134	4,571	2,010	1,562	4,003	1,755	1,373	568	255	189
Milwaukee	458	124	279	300	65	209	158	59	70	1,381	646	530	1,102	504	446	279	142	84
Minneapolis – St. Paul	287	33	155	136	23	113	71	10	42	491	178	309	403	145	176	88	33	33
St. Louis	382	184	106	224	149	70	78	35	36	745	390	224	640	330	203	105	60	21
Kansas City – Tulsa	147	18	99	98	•	66	49	•	33	455	233	124	341	168	95	114	65	29
Dallas – Houston	188	41	108	123	37	64	65	•	44	551	253	131	452	207	91	99	46	40
Denver	143	62	81	92	29	62	51	33	19	401	186	96	324	154	82	77	32	14
Seattle – Portland	194	62	106	125	34	83	69	28	23	352	178	110	273	138	89	79	40	21
San Francisco	228	86	122	132	46	77	96	40	45	570	284	149	401	214	97	169	70	52
Los Angeles	496	188	124	250	82	85	246	106	39	1,737	895	216	1,431	773	176	306	122	40
TOTAL	12,279	4,289	6,111	8,160	2,841	4,521	4,119	1,448	1,590	35,770	15,922	11,447	29,227	13,066	9,383	6,543	2,856	2,064

Pipe Cutting, Polishing & Buffing

	Total Units	10 Yrs & Over	Over 20 Yrs
Polishing stands, bench & floor	40,640	53%	11%
Speed lathes	13,765	66	19
Abrasive-belt, disk, drum	20,727	46	6
Other	7,599	46	10
Total polishing & buffing	82,731	53	11
Total pipe cutting & threading	14,651	54	14

• – Less than 10

	PIPE CUTTING & THREADING MACHINES			TOTAL POLISHING & BUFFING MACHINES			POLISHING STANDS (BENCH & FLOOR)			SPEED LATHES			ABRASIVE-BELT, DISK, DRUM			OTHER		
	TOTAL	10-20 YEARS	OVER 20 YR	TOTAL	10-20 YEARS	OVER 20 YR	TOTAL	10-20 YEARS	OVER 20 YR	TOTAL	10-20 YEARS	OVER 20 YR	TOTAL	10-20 YEARS	OVER 20 YR	TOTAL	10-20 YEARS	OVER 20 YR
BY INDUSTRY																		
Farm Machinery	266	137	37	837	483	197	431	266	135	133	52	48	225	156	•	48	•	11
Construction, Mining, Mat. Hdlg.	746	297	122	584	244	72	283	124	55	68	44	•	198	58	14	35	18	•
Metalworking Machinery	650	254	75	4,397	1,973	647	1,577	775	226	1,346	619	307	1,327	556	100	147	23	14
Special Industry Machinery	650	284	114	3,644	1,624	713	1,483	810	270	972	358	349	952	378	76	237	78	18
General Industrial Equipment	968	435	116	4,199	2,092	509	1,732	820	211	1,440	894	176	843	326	47	184	52	75
Fabricated Metal Products	5,417	2,049	784	23,013	8,276	2,475	12,186	4,108	1,564	2,309	815	479	5,598	2,312	260	2,920	1,041	172
Office and Service Machines	628	210	113	2,631	1,044	583	1,255	536	334	275	144	62	737	284	99	364	80	88
Electrical Equipment	794	246	163	4,706	1,611	695	2,181	721	437	529	193	52	1,465	486	98	531	211	108
Household Appliances	207	74	38	1,733	788	367	892	494	194	188	44	114	273	134	12	380	116	47
Communications Equipment	281	64	•	2,060	652	182	808	240	84	421	223	42	646	154	15	185	35	41
Motor Vehicles and Parts	746	215	78	6,176	2,068	798	3,195	1,095	405	1,259	278	319	713	221	24	1,009	474	50
Complete Aircraft	117	52	•	1,341	443	33	154	85	•	68	26	•	1,091	324	27	28	•	•
Aircraft Engines, Props, Parts	393	234	14	4,477	2,132	74	1,724	835	30	1,048	649	16	1,399	544	15	306	104	13
Precision Mechanisms	278	152	23	5,230	2,228	560	2,241	900	236	1,203	621	245	1,163	478	52	623	229	27
Ordnance, Shipbuilding, Railroads	1,112	675	159	2,762	1,588	365	1,136	702	105	705	411	70	765	406	112	156	69	78
Forge Shops, Foundries, Misc.	1,398	525	194	14,941	7,305	889	9,362	4,558	290	1,801	1,162	263	3,332	1,418	306	446	167	30
TOTAL	14,651	5,903	2,039	82,731	34,551	9,159	40,640	17,069	4,580	13,765	6,533	2,547	20,727	8,235	1,260	7,599	2,714	772
BY GEOGRAPHIC AREA																		
Boston	890	395	132	11,402	5,802	1,243	6,843	3,466	554	1,565	742	506	2,276	1,208	98	718	386	85
Bridgeport – Hartford	358	165	72	5,403	2,632	841	2,131	1,101	405	1,373	878	164	1,261	485	98	638	168	174
New York – Newark	1,228	524	124	7,751	3,068	752	3,975	1,448	293	1,480	870	291	1,840	670	120	456	77	48
Buffalo – Syracuse	519	235	69	3,838	1,467	533	2,062	759	358	319	133	79	1,078	372	77	379	203	19
Philadelphia – Camden	1,102	417	282	4,236	1,219	354	2,401	673	170	416	165	45	1,023	234	127	396	147	12
Pittsburgh – Wheeling	963	369	251	1,985	1,015	118	944	385	65	183	105	23	752	443	15	106	82	15
Baltimore	327	156	52	1,238	663	115	519	290	42	289	160	39	398	209	34	32	•	•
Richmond	433	244	45	1,688	770	76	550	304	32	335	197	•	703	257	38	100	12	•
Atlanta – New Orleans	637	311	91	1,358	583	103	761	345	69	128	76	19	363	117	15	106	45	•
Cleveland	750	305	84	4,369	1,877	656	2,283	865	355	854	449	199	985	436	76	247	127	26
Toledo	174	66	•	1,843	663	65	796	312	48	298	31	11	467	238	•	282	82	•
Cincinnati – Louisville	631	272	96	3,832	1,252	632	2,247	579	433	502	274	163	670	292	25	413	107	11
Detroit	801	240	74	8,267	2,937	1,074	3,962	1,361	414	1,675	572	468	1,288	498	59	1,342	506	133
Indianapolis	290	115	33	2,528	1,088	464	1,226	521	212	465	245	67	536	199	103	301	123	82
Chicago	1,789	633	244	10,348	4,645	1,145	5,043	2,615	549	1,789	691	269	2,741	980	211	775	359	116
Milwaukee	637	172	80	2,236	1,054	455	1,005	457	258	539	260	137	558	275	47	134	62	13
Minneapolis – St. Paul	246	140	26	1,439	352	61	392	140	53	56	22	•	484	186	•	507	•	•
St. Louis	371	176	49	943	413	153	494	189	85	70	33	23	327	173	41	52	18	•
Kansas City – Tulsa	228	107	•	589	232	25	128	73	•	150	59	•	306	95	17	•	•	•
Dallas – Houston	461	170	25	979	328	48	471	123	30	93	45	•	399	158	16	16	•	•
Denver	330	121	54	819	394	•	249	185	•	253	156	•	245	185	•	72	68	•
Seattle – Portland	269	158	42	677	200	94	183	70	64	52	21	•	407	93	21	35	16	•
San Francisco	335	150	52	551	238	78	287	141	54	54	10	13	186	79	•	24	•	•
Los Angeles	882	262	47	4,412	1,462	66	1,688	667	28	827	339	11	1,434	353	•	463	103	27
TOTAL	14,651	5,903	2,039	82,731	34,551	9,159	40,640	17,069	4,580	13,765	6,533	2,547	20,727	8,235	1,260	7,599	2,714	772

Threading Machines

	TOTAL THREADING MACHINES (EXCEPT PIPE)			TAPPING			HOBBING & MILLING			DIE TYPE			THREAD GRINDERS			THREAD ROLLING MACHINES			OTHER		
	TOTAL	10-20 YEARS	OVER 20 YR	TOTAL	10-20 YEARS	OVER 20 YR	TOTAL	10-20 YEARS	OVER 20 YR	TOTAL	10-20 YEARS	OVER 20 YR	TOTAL	10-20 YEARS	OVER 20 YR	TOTAL	10-20 YEARS	OVER 20 YR	TOTAL	10-20 YEARS	OVER 20 YR
BY INDUSTRY																					
Farm Machinery	1,046	464	284	642	275	170	56	26	•	254	123	80	15	10	•	13	•	10	66	30	13
Const., Mining, Mat. Hdlg.	1,054	449	204	256	96	17	281	149	85	353	131	82	55	38	•	13	•	•	96	33	12
Metalworking Machinery	3,572	1,907	621	607	216	57	1,107	530	367	179	81	44	1,448	985	111	116	46	14	115	49	28
Special-Industry Machinery	737	294	224	353	174	66	164	66	66	130	23	63	25	12	•	41	14	•	24	•	19
General Industrial Equipment	2,985	1,582	389	1,105	551	95	848	502	182	176	85	45	630	401	49	115	39	18	31	•	•
Fabricated Metal Products	14,765	5,736	3,108	6,105	2,562	768	421	256	67	2,363	891	828	475	352	35	3,921	1,108	1,057	1,480	567	353
Office and Service Machines	1,900	878	494	936	329	262	79	58	•	112	43	32	35	21	•	64	•	31	674	420	165
Electrical Equipment	3,903	1,784	751	2,769	1,257	442	213	99	59	259	134	59	77	70	•	441	127	153	144	97	38
Household Appliances	663	336	85	537	275	83	30	23	•	21	19	•	10	•	•	47	11	•	18	•	•
Communications Equipment	1,123	582	144	986	532	120	32	•	19	15	•	•	15	•	•	51	33	•	24	•	•
Motor Vehicles and Parts	2,177	610	536	1,000	311	256	140	29	31	258	102	83	317	92	23	303	61	133	159	15	10
Complete Aircraft	131	54	•	36	17	•	18	11	•	25	•	•	48	18	•	•	•	•	•	•	•
Aircraft Engines, Props, Parts	2,950	1,908	24	1,279	735	•	428	326	•	241	135	•	759	554	•	171	117	•	72	41	•
Precision Mechanisms	1,638	650	324	1,041	396	144	69	25	27	15	•	•	178	151	11	90	12	53	245	65	88
Ordnance, Shipbuilding, Railroads	1,504	764	310	514	256	100	588	304	77	138	80	43	141	91	•	14	•	•	109	28	81
Forge Shops, Foundries, Misc.	3,137	1,189	283	1,678	586	114	211	95	29	334	142	63	422	244	•	183	109	34	309	13	43
TOTAL	43,205	19,187	7,781	19,844	8,568	2,700	4,685	2,503	1,030	4,873	1,996	1,428	4,650	3,054	257	5,585	1,693	1,515	3,568	1,373	851
BY GEOGRAPHIC AREA																					
Boston	2,993	1,497	746	1,287	706	207	388	217	105	360	154	145	304	254	•	546	133	242	108	33	39
Bridgeport – Hartford	3,440	1,449	979	1,120	417	249	505	180	240	172	30	30	486	300	56	341	61	180	816	461	224
New York – Newark	4,291	1,766	345	1,893	640	140	634	347	74	290	97	69	437	293	•	773	277	57	264	112	•
Buffalo – Syracuse	1,969	955	401	1,139	594	184	158	96	41	81	45	•	82	38	•	132	20	33	377	162	131
Philadelphia – Camden	1,681	873	299	831	418	125	204	141	25	318	175	56	205	113	22	50	10	19	73	16	52
Pittsburgh – Wheeling	833	331	191	301	97	48	39	23	•	221	100	70	48	46	•	202	65	62	22	•	•
Baltimore	522	209	93	215	74	28	150	62	52	76	39	13	63	26	•	•	•	•	13	•	•
Richmond	863	351	94	392	219	53	94	65	•	80	48	19	17	13	•	•	•	•	271	•	20
Atlanta – New Orleans	1,011	443	270	582	248	174	59	11	30	208	84	51	54	36	•	90	53	15	18	11	•
Cleveland	3,256	1,507	869	1,049	566	158	561	273	171	389	116	227	377	237	47	782	274	253	98	41	13
Toledo	486	120	33	315	45	12	33	15	11	50	18	10	35	26	•	13	•	•	40	14	•
Cincinnati – Louisville	1,597	579	376	989	266	283	159	90	32	134	77	27	92	67	•	187	72	17	36	•	11
Detroit	4,771	2,185	995	1,992	873	360	415	250	33	466	161	240	985	629	50	586	149	227	327	123	85
Indianapolis	1,874	679	390	1,114	446	214	153	95	26	107	29	35	156	64	•	227	44	110	117	•	•
Chicago	6,515	3,063	951	3,208	1,536	182	509	243	125	821	349	156	493	356	38	827	283	274	657	296	176
Milwaukee	1,347	653	217	751	348	105	151	103	22	220	98	68	104	80	•	40	•	•	81	20	15
Minneapolis – St. Paul	599	240	143	389	159	60	31	17	•	115	16	74	25	25	•	35	19	•	•	•	•
St. Louis	467	238	65	302	170	30	35	15	19	54	27	•	27	13	•	41	13	•	•	•	•
Kansas City – Tulsa	426	211	87	177	102	10	21	14	•	148	56	56	32	23	•	•	•	•	44	12	16
Dallas – Houston	654	279	51	225	108	•	86	52	•	182	82	34	67	37	•	34	•	•	60	•	•
Denver	379	204	32	130	58	•	79	44	•	110	65	16	31	30	•	10	•	•	19	•	11
Seattle – Portland	223	102	49	158	75	30	•	•	•	30	•	•	18	16	•	•	•	•	10	•	•
San Francisco	318	144	77	102	30	23	56	37	•	76	50	•	13	•	•	12	•	•	59	15	37
Los Angeles	2,690	1,109	28	1,183	373	18	159	109	•	165	76	•	499	328	•	638	199	•	46	24	•
TOTAL	43,205	19,187	7,781	19,844	8,568	2,700	4,685	2,503	1,030	4,873	1,996	1,428	4,650	3,054	257	5,585	1,693	1,515	3,568	1,373	851

• – Less than 10

	Total Units	10 Yrs & Over	Over 20 Yrs
Tapping	19,844	57%	14%
Hobbing and milling	4,685	75	22
Die type	4,873	70	29
Grinders, thread	4,650	71	6
Rolling machines, thread	5,585	56	27
Other	3,568	62	24
Total	43,205	62	18

Special Multi-Station, Electro-Erosion, Ultrasonic, Other Metal-Cutting Machines

	Total Units	10 Yrs & Over	Over 20 Yrs
In-line and transfer	8,596	3%	1%
Dial or rotary table	3,819	31	11
Automatic assembly	3,843	25	43
Total multi-station machines	16,258	15	4
Total electro-erosion mach.	578	13	0
Total ultrasonic cutting	178	10	0
Total other metal-cutting	6,702	56	23

* – Less than 10

	ELECTRO-EROSION MACHINES			ULTRASONIC CUTTING MACHINES			TOTAL SPECIAL MULTI-STATION MACHINES			IN-LINE & TRANSFER			DIAL OR ROTARY TABLE			AUTOMATIC ASSEMBLY (ALL TYPES)			OTHER METAL-CUTTING MACHINES		
	TOTAL	10-20 YEARS	OVER 20 YR	TOTAL	10-20 YEARS	OVER 20 YR	TOTAL	10-20 YEARS	OVER 20 YR	TOTAL	10-20 YEARS	OVER 20 YR	TOTAL	10-20 YEARS	OVER 20 YR	TOTAL	10-20 YEARS	OVER 20 YR	TOTAL	10-20 YEARS	OVER 20 YR
BY INDUSTRY																					
Farm Machinery	*	*	*	*	*	*	56	13	*	22	*	*	11	*	*	23	*	*	153	64	*
Const., Mining, Mat. Hdlg.	20	*	*	*	*	*	49	*	*	*	*	*	29	*	*	13	*	*	105	27	39
Metalworking Machinery	112	18	*	29	*	*	180	37	*	*	*	*	86	33	*	11	*	*	803	345	202
Special-Industry Machinery	26	*	*	*	*	*	47	19	*	*	*	*	14	*	*	28	14	*	208	69	71
General Industrial Equipment	34	*	*	*	*	*	332	61	42	81	*	*	189	31	40	62	23	*	575	263	158
Fabricated Metal Products	74	*	*	*	*	*	2,077	577	497	330	60	48	1,166	249	324	581	288	125	1,712	587	856
Office and Service Machines	*	*	*	*	*	*	1,554	61	18	1,314	*	*	225	44	18	215	37	*	458	35	142
Electrical Equipment	30	13	*	*	*	*	698	184	22	31	*	*	280	61	*	367	119	13	388	139	66
Household Appliances	*	*	*	*	*	*	152	11	*	35	*	*	115	10	*	*	*	*	149	72	45
Communications Equipment	11	*	*	39	*	*	411	68	*	27	*	*	97	19	*	287	49	*	175	21	26
Motor Vehicles and Parts	10	*	*	17	*	*	8,249	149	42	6,432	23	*	581	108	21	1,236	38	13	779	164	70
Complete Aircraft	37	*	*	*	*	*	15	*	*	*	*	*	*	*	*	*	*	*	56	18	*
Aircraft Engines, Props, Parts	120	*	*	30	*	*	643	54	*	32	*	*	307	32	*	304	22	*	151	28	*
Precision Mechanisms	28	*	*	*	*	*	445	48	*	47	*	*	327	46	*	71	*	*	183	105	40
Ordnance, Shipbuilding, Railroads	*	*	*	*	*	*	309	148	*	*	*	*	30	*	*	227	161	*	36	18	*
Forge Shops, Foundries, Misc.	50	*	*	25	*	*	1,121	300	*	425	121	*	359	125	*	337	54	*	794	289	94
Total	578	77	*	178	18	*	16,258	1,798	644	8,596	207	58	3,819	778	421	3,843	813	165	6,702	2,225	1,534
BY GEOGRAPHIC AREA																					
Boston	35	*	*	31	*	*	436	118	*	22	*	*	267	84	*	167	29	*	577	244	123
Bridgeport – Hartford	36	*	*	*	*	*	422	70	41	59	19	*	280	43	16	83	*	25	415	94	216
New York – Newark	39	*	*	18	*	*	905	185	47	397	105	*	227	41	*	281	39	38	367	200	55
Buffalo – Syracuse	47	18	*	*	*	*	399	38	46	242	15	*	114	22	38	43	*	*	190	61	11
Philadelphia – Camden	34	*	*	*	*	*	380	155	17	25	12	*	216	89	15	139	54	*	209	55	50
Pittsburgh – Wheeling	21	*	*	*	*	*	93	29	12	11	*	*	82	25	12	*	*	*	198	378	91
Baltimore	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	*	74	16	23
Richmond	*	*	*	15	*	*	43	*	*	30	*	*	*	*	*	*	*	*	28	*	*
Atlanta – New Orleans	*	*	*	*	*	*	669	108	303	105	18	46	360	34	221	204	56	36	135	26	47
Cleveland	21	*	*	*	*	*	666	41	*	312	*	*	260	18	*	94	18	*	319	37	148
Toledo	*	*	*	10	*	*	391	15	*	280	*	*	64	15	*	47	*	*	173	19	17
Cincinnati – Louisville	13	*	*	*	*	*	1,372	54	64	1,100	*	*	157	31	41	115	23	23	563	184	213
Detroit	57	11	*	24	*	*	6,622	367	21	4,346	*	*	732	113	*	1,544	249	18	962	279	117
Indianapolis	14	*	*	*	*	*	1,521	65	32	1,232	*	*	193	55	25	96	*	*	270	45	35
Chicago	78	11	*	19	11	*	1,082	199	12	338	*	*	360	89	*	384	107	*	1,036	328	303
Milwaukee	21	*	*	*	*	*	130	20	*	28	*	*	90	14	*	12	*	*	126	61	17
Minneapolis – St. Paul	*	*	*	*	*	*	43	11	*	*	*	*	23	*	*	12	*	*	77	50	*
St. Louis	33	*	*	*	*	*	323	99	36	*	*	*	171	41	36	148	55	*	*	*	*
Kansas City – Tulsa	*	*	*	*	*	*	306	177	*	*	*	*	15	12	*	291	165	*	34	20	*
Dallas – Houston	*	*	*	*	*	*	58	*	*	*	*	*	15	*	*	40	*	*	81	21	*
Denver	*	*	*	*	*	*	17	*	*	*	*	*	*	*	*	*	*	*	33	13	*
Seattle – Portland	*	*	*	*	*	*	27	11	*	*	*	*	26	11	*	*	*	*	33	*	18
San Francisco	*	*	*	*	*	*	20	*	*	*	*	*	12	*	*	*	*	*	44	11	11
Los Angeles	87	11	*	27	*	*	330	31	*	43	*	*	160	31	*	127	*	*	244	73	19
Total	578	77	*	178	18	*	16,258	1,798	644	8,596	207	58	3,819	778	421	3,843	813	165	6,702	2,225	1,534

Bending & Forming, Wire and Strip Forming Machines

	Total Units	10 Yrs & Over	Over 20 Yrs
Bending rolls, sheet & plate	17,970	63%	22%
Bending rolls, bars & shapes	4,537	61	18
Bending brakes	28,255	51	12
Rotary bending & forming	4,811	47	14
Benders — pipe, bar, shapes	9,799	46	10
Total bending & forming	65,372	54	15
Total wire & strip forming	16,815	57	24

• – Less than 10

	TOTAL BENDING & FORMING MACHINES (POWER)			BENDING ROLLS, SHEET & PLATE			BENDING ROLLS, BARS & SHAPES			BENDING BRAKES			ROTARY BENDING & FORMING MACHINES			BENDING MACHINES, PIPE, BAR, & SHAPES			WIRE & STRIP FORMING MACHINES		
	TOTAL	10–20 YEARS	OVER 20 YR	TOTAL	10–20 YEARS	OVER 20 YR	TOTAL	10–20 YEARS	OVER 20 YR	TOTAL	10–20 YEARS	OVER 20 YR	TOTAL	10–20 YEARS	OVER 20 YR	TOTAL	10–20 YEARS	OVER 20 YR	TOTAL	10–20 YEARS	OVER 20 YR
BY INDUSTRY																					
Farm Machinery	1,754	868	321	515	240	134	189	101	59	756	339	74	72	26	25	222	102	31	59	26	•
Construction, Mining, Materials Handling	2,252	831	523	808	299	281	212	88	56	865	300	110	162	39	57	205	105	19	34	•	•
Metalworking Machinery	1,289	446	250	323	103	108	108	45	21	525	183	73	112	34	10	221	81	38	83	•	•
Special-Industry Machinery	2,581	1,098	614	896	412	264	297	158	73	943	367	221	124	59	22	291	122	34	239	68	136
General Industrial Equipment	2,241	887	576	789	353	242	224	99	33	798	280	206	124	47	54	306	106	41	228	105	42
Fabricated Metal Products	26,044	10,572	3,947	7,888	3,538	1,722	2,139	904	328	10,425	4,011	1,176	2,076	653	268	3,516	1,446	453	10,913	3,787	3,031
Office and Service Machines	4,020	1,458	711	1,174	480	236	133	59	41	2,213	789	366	176	91	•	324	99	68	225	63	35
Electrical Equipment	3,731	1,174	615	849	229	174	199	64	52	2,100	762	293	258	70	49	325	49	47	1,383	338	220
Household Appliances	1,337	489	119	493	153	43	84	20	•	577	270	74	78	17	•	105	29	•	173	43	35
Communications Equipment	1,540	535	98	232	93	13	35	13	•	960	340	36	199	82	39	134	•	10	757	235	63
Motor Vehicles and Parts	2,933	810	444	912	234	137	161	50	40	769	260	150	248	53	47	843	233	90	367	85	43
Complete Aircraft	2,566	935	85	356	162	•	114	67	•	749	303	16	400	181	12	947	242	•	27	•	•
Aircraft Engines, Propellers, and Parts	2,327	846	95	620	225	43	243	104	12	737	217	23	233	119	11	494	181	•	304	59	•
Precision Mechanisms	1,485	652	164	459	246	54	47	24	15	790	272	84	60	21	•	189	69	•	138	29	66
Ordnance, Shipbuilding, Railroads	1,959	904	488	713	281	233	84	43	35	513	270	80	212	79	50	457	231	90	199	62	103
Forge Shops, Foundries, Miscellaneous	7,343	2,817	1,008	963	354	281	268	132	72	4,595	1,925	537	277	34	37	1,240	372	81	1,716	701	197
TOTAL	65,372	25,282	10,028	17,970	7,402	3,971	4,537	1,951	837	28,255	10,888	3,519	4,811	1,585	683	9,799	3,456	1,018	16,815	5,644	4,004
BY GEOGRAPHIC AREA																					
Boston	3,256	1,279	551	869	402	217	246	117	56	1,303	519	178	463	111	43	375	130	57	1,230	280	465
Bridgeport – Hartford	1,938	952	289	792	490	101	79	48	•	712	316	58	119	48	24	236	50	72	643	89	286
New York – Newark	5,237	1,983	811	1,230	418	354	496	228	82	2,618	1,022	285	267	87	59	646	228	51	1,084	505	126
Buffalo – Syracuse	2,279	994	416	728	244	146	160	85	39	1,389	521	166	166	51	18	336	93	27	844	280	83
Philadelphia – Camden	4,294	1,603	634	1,680	442	218	369	118	46	1,924	731	276	288	47	10	633	265	84	457	179	11
Pittsburgh – Wheeling	2,206	781	442	767	271	303	139	67	53	815	287	143	120	34	27	365	122	116	856	474	169
Baltimore	1,185	513	153	304	120	61	58	24	•	452	163	46	205	139	23	166	67	14	55	29	12
Richmond	1,609	712	227	487	217	60	124	49	36	557	189	89	77	37	22	364	220	20	293	23	148
Atlanta – New Orleans	2,393	952	389	682	301	189	183	73	32	907	323	114	145	38	37	476	217	17	112	48	•
Cleveland	2,814	1,077	586	729	286	159	136	63	50	1,322	528	283	254	67	48	373	133	46	633	168	123
Toledo	809	348	63	190	71	34	25	14	•	341	135	19	18	16	•	235	112	•	46	18	•
Cincinnati – Louisville	4,364	1,562	752	1,757	600	374	431	91	53	1,586	681	234	194	66	28	396	124	63	674	127	63
Detroit	3,695	1,141	652	1,085	297	285	251	107	40	1,097	417	189	306	66	67	956	254	71	700	156	145
Indianapolis	1,998	787	271	613	301	88	71	24	13	643	234	98	397	187	40	184	41	32	835	410	79
Chicago	9,301	3,646	1,264	2,257	976	473	555	295	80	4,865	1,812	562	553	164	55	1,071	419	94	5,557	1,849	1,870
Milwaukee	2,286	860	545	583	249	182	187	87	49	978	330	192	168	73	63	370	121	79	290	34	21
Minneapolis – St. Paul	1,508	595	357	422	175	121	120	54	34	635	187	121	157	59	74	174	120	•	220	44	78
St. Louis	2,128	916	313	393	174	68	112	55	18	1,091	485	160	163	75	•	369	127	64	437	146	123
Kansas City – Tulsa	1,641	973	279	518	281	109	187	84	64	927	518	86	32	•	•	177	87	12	357	184	•
Dallas – Houston	2,519	900	226	760	333	129	124	62	•	1,131	390	69	226	36	•	278	97	20	140	49	19
Denver	866	324	154	241	105	68	58	20	16	328	114	42	53	31	10	126	54	16	34	23	•
Seattle – Portland	725	391	141	267	176	68	72	40	19	260	122	33	12	•	•	114	44	21	•	•	•
San Francisco	1,134	461	96	298	159	49	125	36	16	441	187	23	70	13	•	200	66	•	604	345	92
Los Angeles	4,637	1,512	227	938	334	95	229	110	16	1,933	677	53	358	126	16	1,179	265	47	756	244	76
TOTAL	65,372	25,282	10,028	17,970	7,402	3,971	4,537	1,951	837	28,255	10,888	3,519	4,811	1,585	683	9,799	3,456	1,018	16,815	5,644	4,004

Hydraulic, Pneumatic Presses

	Total Units	10 Yrs & Over	Over 20 Yrs
Vertical, single action	22,950	52%	13%
Vertical, double-triple act.	3,580	55	15
Horizontal	3,152	62	24
Extrusion	452	47	18
Other	3,045	46	10
Total hydraulic presses	33,179	52	14
Total pneumatic presses	6,991	45	5

• – Less than 10

	TOTAL HYDRAULIC PRESSES			VERTICAL SINGLE ACTION			VERTICAL DOUBLE & TRIPLE ACTION			HORIZONTAL			EXTRUSION (FROM HOT BILLETS)			OTHER (INCL. STRETCH & HYDRO-PNEUMATIC			PNEUMATIC PRESSES (EXCEPT HYDRO-PNEUMATIC)		
	TOTAL	10–20 YEARS	OVER 20 YR	TOTAL	10–20 YEARS	OVER 20 YR	TOTAL	10–20 YEARS	OVER 20 YR	TOTAL	10–20 YEARS	OVER 20 YR	TOTAL	10–20 YEARS	OVER 20 YR	TOTAL	10–20 YEARS	OVER 20 YR	TOTAL	10–20 YEARS	OVER 20 YR
BY INDUSTRY																					
Farm Machinery	1,176	429	256	700	251	151	227	102	23	197	66	44	22	•	16	30	•	22	242	93	44
Construction, Mining, Materials Handling	2,226	896	367	1,259	588	182	85	30	•	357	99	122	•	•	•	545	179	63	67	34	16
Metalworking Machinery	1,531	642	208	1,229	540	123	72	26	•	73	18	30	•	•	•	157	58	48	92	44	•
Special-Industry Machinery	998	383	218	737	293	151	51	21	•	177	69	65	•	•	•	33	•	•	116	44	18
General Industrial Equipment	1,917	829	333	1,449	643	202	202	95	36	135	40	63	15	•	10	116	49	22	361	167	30
Fabricated Metal Products	5,702	2,294	732	3,965	1,741	480	532	241	82	673	239	122	124	•	17	408	69	31	1,088	476	54
Office and Service Machines	1,085	301	125	815	231	69	124	30	45	40	•	•	•	•	•	76	31	11	220	75	•
Electrical Equipment	5,198	1,848	713	3,711	1,230	531	910	434	96	126	40	13	150	79	18	301	65	55	1,447	730	49
Household Appliances	708	254	127	415	159	81	191	58	44	36	•	•	•	•	•	62	29	•	208	125	14
Communications Equipment	1,434	326	82	1,015	223	64	142	67	18	167	32	•	•	•	•	110	•	•	648	126	•
Motor Vehicles and Parts	1,949	430	351	1,424	314	284	153	52	20	57	17	•	77	18	21	238	29	21	384	126	11
Complete Aircraft	589	240	10	320	132	•	60	22	•	•	•	•	•	•	•	204	82	•	20	14	•
Aircraft Engines, Propellers, and Parts	2,044	1,445	78	1,438	841	63	213	40	12	533	427	•	18	18	•	442	339	•	397	245	24
Precision Mechanisms	1,038	388	77	904	230	63	86	49	•	29	•	•	•	•	•	19	•	10	842	168	24
Ordnance, Shipbuilding, Railroads	1,739	794	451	1,144	564	242	215	61	107	169	73	75	•	•	•	211	96	27	328	161	99
Forge Shops, Foundries, Miscellaneous	3,075	1,027	616	2,245	840	357	317	85	51	379	74	204	41	•	•	93	27	•	391	147	•
TOTAL	33,179	12,446	4,744	22,950	8,820	3,048	3,580	1,413	550	3,152	1,214	743	452	128	82	3,045	1,071	321	6,991	2,775	374
BY GEOGRAPHIC AREA																					
Boston	1,790	649	372	1,299	480	172	191	63	75	159	24	104	47	•	•	184	78	21	780	410	12
Bridgeford – Hartford	1,015	328	84	763	246	47	122	46	15	54	•	16	•	•	•	72	11	•	521	170	•
New York – Newark	3,018	1,527	308	1,645	525	193	395	150	71	568	497	21	28	18	•	422	337	16	621	157	71
Buffalo – Syracuse	1,499	616	283	1,299	416	220	174	97	•	95	51	21	48	48	•	83	•	42	416	110	•
Philadelphia – Camden	1,470	428	256	1,072	374	164	79	11	36	228	13	52	•	•	•	84	26	•	164	12	•
Pittsburgh – Wheeling	1,856	667	443	1,085	467	223	324	84	157	333	103	54	25	•	•	69	•	•	210	104	41
Baltimore	534	263	119	388	183	102	29	24	•	43	14	•	•	•	•	73	42	•	106	58	26
Richmond	657	228	90	424	162	58	54	11	•	59	21	23	•	•	•	120	34	•	132	27	18
Atlanta – New Orleans	931	388	197	616	281	122	64	33	10	170	70	53	27	•	11	54	•	•	63	41	14
Cleveland	2,218	1,141	270	1,613	1,000	177	146	64	38	174	19	44	112	22	•	153	36	•	469	221	•
Toledo	459	185	65	276	110	47	108	67	•	31	•	13	•	•	•	44	•	•	148	34	19
Cincinnati – Louisville	1,281	519	155	914	397	124	108	54	•	65	28	•	69	18	18	45	22	•	103	51	•
Detroit	2,323	670	317	1,755	547	203	162	23	•	42	•	11	24	•	21	340	91	79	413	108	•
Indianapolis	1,257	403	173	878	259	136	241	111	17	21	13	•	•	•	•	111	18	17	242	140	•
Chicago	4,621	1,445	656	2,841	1,108	410	592	234	59	392	95	82	50	•	16	746	223	89	1,042	368	77
Milwaukee	1,576	548	274	1,013	312	183	330	155	24	199	62	59	•	•	•	32	19	•	421	176	13
Minneapolis – St. Paul	437	174	57	352	152	33	23	18	•	49	•	24	•	•	•	13	•	•	76	26	•
St. Louis	1,363	302	58	955	263	39	74	19	•	38	15	19	•	•	•	16	•	•	364	217	23
Kansas City – Tulsa	838	241	132	733	208	117	20	•	•	54	17	14	•	•	•	30	14	•	239	129	•
Dallas – Houston	574	256	77	399	146	39	78	18	•	74	19	35	•	•	•	22	•	•	75	37	10
Denver	435	233	53	295	168	30	50	28	•	34	•	13	•	•	•	56	30	10	35	•	•
Seattle – Portland	294	153	57	208	115	26	26	14	•	53	17	25	•	•	•	•	•	•	•	•	•
San Francisco	548	180	89	393	153	45	30	•	•	86	22	39	•	•	•	31	•	•	22	•	•
Los Angeles	2,353	932	199	1,824	728	140	180	66	12	131	84	•	•	•	•	218	54	•	306	81	•
TOTAL	33,179	12,446	4,744	22,950	8,820	3,048	3,580	1,413	550	3,152	1,214	743	452	128	82	3,045	1,071	321	6,991	2,775	374

	Total Units	10 Yrs & Over	Over 20 Yrs
Inclinable, sing-action	123,394	65%	24%
Straight-side	41,383	70	36
Gap or C-frame	35,312	66	31
Adj. bed & horning	10,330	71	32
Double & triple action	5,466	64	28

	Total Units	10 Yrs & Over	Over 20 Yrs
Dieing machines	2,090	46%	16%
Horizontal	2,205	74	41
Multiple transfer	3,569	65	17
Other	16,834	62	33
Total	240,583	66	28

◆ – Less than 10

	TOTAL MECHANICAL PRESSES			INCLINABLE, SINGLE-ACTION			STRAIGHT-SIDE (INCL. ARCH)			VERTICAL, SINGLE GAP OR C-FRAME			ADJUSTABLE BED & HORNING			DOUBLE & TRIPLE ACTION			DIEING MACHINES			HORIZONTAL (INCL. BULLDOZERS)			MULTIPLE TRANSFER (INCL. EYELETTING)			OTHER MECHANICAL PRESSES		
	10–20 TOTAL YEARS	OVER 20 YR		10–20 TOTAL YEARS	OVER 20 YR		10–20 TOTAL YEARS	OVER 20 YR		10–20 TOTAL YEARS	OVER 20 YR		10–20 TOTAL YEARS	OVER 20 YR		10–20 TOTAL YEARS	OVER 20 YR		10–20 TOTAL YEARS	OVER 20 YR		10–20 TOTAL YEARS	OVER 20 YR		10–20 TOTAL YEARS	OVER 20 YR		10–20 TOTAL YEARS	OVER 20 YR	
BY INDUSTRY																													
Fam Machinery	4,547	1,955	1,461	1,810	861	458	789	409	290	845	335	324	284	101	168	20	10	◆	◆	◆	◆	219	64	79	◆	◆	◆	577	171	138
Const., Mining, Mat. Hdlg.	3,182	835	707	1,909	420	266	590	160	174	335	157	105	47	◆	16	23	◆	◆	◆	◆	◆	194	63	58	◆	◆	◆	80	11	39
Metalworking Machinery	4,315	1,984	1,119	2,289	940	471	836	307	208	492	196	152	58	18	21	285	98	52	70	22	14	18	◆	12	27	21	◆	320	80	180
Special-Industry Machinery	2,617	995	967	1,617	544	583	225	138	173	342	133	146	67	37	24	57	◆	26	21	◆	◆	44	◆	15	◆	◆	◆	144	65	31
General Industrial Equipment	6,149	2,257	2,294	2,377	895	733	1,434	420	652	1,138	389	658	67	29	32	64	18	21	11	◆	◆	51	12	39	19	12	◆	960	553	147
Fabricated Metal Products	97,711	39,616	28,236	56,199	23,809	12,856	14,067	5,445	6,199	13,790	4,991	4,274	4,108	1,770	1,386	2,237	1,070	616	646	199	99	826	284	377	960	382	97	4,878	1,927	2,252
Office and Service Machines	10,375	3,903	3,610	5,274	2,052	1,746	2,712	1,013	835	1,117	333	602	409	180	200	86	13	36	190	84	13	◆	◆	◆	28	10	◆	550	172	173
Electrical Equipment	26,196	9,777	8,025	12,653	5,298	3,613	4,987	1,487	1,644	3,533	1,384	1,116	1,065	315	426	1,064	188	380	430	130	56	174	52	53	898	348	180	1,431	595	518
Household Appliances	5,866	2,268	1,219	2,780	1,154	611	1,458	557	241	799	252	185	398	203	80	193	64	63	34	20	◆	67	34	25	44	◆	◆	93	27	14
Communications Equipment	7,237	2,841	1,016	5,080	2,148	772	745	282	88	538	183	55	107	114	23	68	◆	◆	47	◆	◆	144	86	40	235	69	21	213	31	12
Motor Vehicles and Parts	25,858	6,865	7,691	6,521	1,938	1,947	5,022	1,230	881	6,435	1,346	1,940	2,605	700	829	475	31	104	157	32	36	66	23	17	132	◆	28	4,435	768	1,080
Complete Aircraft	1,112	504	41	485	232	19	174	90	◆	113	34	◆	13	◆	◆	40	31	◆	21	◆	◆	17	◆	◆	◆	◆	◆	249	101	15
Aircraft Engines, Props, Parts	4,205	1,604	645	2,464	945	374	751	329	144	326	122	44	154	51	◆	197	47	17	111	30	◆	44	40	◆	36	11	◆	222	30	51
Precision Mechanisms	8,089	3,583	2,453	4,281	1,595	1,207	978	467	318	1,302	684	439	82	74	◆	24	15	◆	84	55	26	27	17	◆	727	543	163	534	123	297
Ordnance, Shipbuilding, Railroads	1,940	970	496	623	361	127	236	151	105	270	181	94	43	16	22	93	75	◆	83	17	61	168	90	47	86	52	21	86	35	14
Forge Shops, Foundries, Misc.	31,194	13,452	7,763	17,072	8,180	3,344	6,169	2,142	2,340	3,837	1,564	943	742	404	45	620	310	125	212	16	11	137	38	95	371	213	88	2,034	635	272
TOTAL	240,583	92,238	67,119	123,394	51,583	29,107	41,383	14,534	14,659	35,312	12,137	11,128	10,330	4,044	3,286	5,466	1,989	1,529	2,090	627	329	2,205	743	981	3,569	1,697	616	16,834	4,984	5,496
BY GEOGRAPHIC AREA																														
Boston	18,016	6,708	5,699	7,989	2,631	1,857	2,964	1,138	1,061	3,132	1,089	1,300	934	588	74	515	263	100	70	19	22	161	16	98	1,022	258	256	1,319	519	290
Bridgeport – Hartford	12,509	5,077	4,560	6,563	2,927	1,999	1,975	419	1,333	2,299	1,077	861	143	56	68	403	224	49	291	115	119	28	13	16	329	59	41	468	191	95
New York – Newark	25,478	11,094	5,838	16,284	7,911	3,472	2,256	1,035	650	3,179	840	737	292	98	110	808	277	189	200	67	17	80	◆	30	489	295	56	1,090	508	729
Buffalo – Syracuse	12,703	3,973	4,465	5,782	2,064	1,674	2,979	794	1,354	1,661	485	610	661	235	247	841	188	307	56	19	◆	66	17	28	185	76	32	512	162	190
Philadelphia – Camden	12,535	4,760	4,085	6,276	2,403	1,531	2,798	895	1,566	1,966	976	456	430	182	209	363	121	124	104	21	24	130	26	86	230	107	11	298	119	68
Pittsburgh – Wheeling	8,385	3,533	2,793	5,549	2,519	1,734	1,232	535	361	577	143	167	154	111	◆	189	81	65	28	◆	◆	96	47	42	74	11	45	496	61	369
Baltimore	1,663	752	592	721	420	190	320	153	72	290	111	111	11	◆	◆	26	◆	◆	23	14	◆	16	◆	◆	◆	◆	◆	288	36	175
Richmond	2,430	1,010	415	1,629	676	282	270	167	36	275	101	93	145	44	◆	37	◆	23	15	◆	◆	◆	◆	◆	21	12	◆	22	◆	◆
Atlanta – New Orleans	4,300	2,059	629	2,220	1,185	365	729	360	141	799	233	156	184	103	56	75	54	14	◆	◆	◆	66	24	36	55	24	19	179	67	41
Cleveland	12,235	4,084	3,666	5,306	2,218	1,452	2,964	812	858	1,602	435	693	674	314	248	249	75	74	93	33	15	195	46	110	16	◆	◆	917	151	316
Toledo	5,140	2,490	628	2,851	1,647	233	795	282	156	977	311	170	115	99	◆	85	53	21	44	19	◆	94	36	37	82	14	◆	97	19	◆
Cincinnati – Louisville	12,880	4,618	3,651	5,251	2,126	1,461	2,566	902	808	2,227	695	679	646	449	141	82	19	35	76	33	◆	112	44	34	76	◆	◆	1,564	338	496
Detroit	30,341	9,407	10,297	11,999	4,208	3,360	5,853	1,771	2,412	5,314	1,443	1,948	1,744	564	580	574	172	144	283	57	32	137	44	48	96	◆	30	4,341	1,146	1,743
Indianapolis	10,789	3,869	3,668	4,954	1,949	1,992	1,837	704	481	1,495	510	719	882	250	375	77	34	24	89	34	25	190	115	49	243	92	77	1,282	471	833
Chicago	37,214	14,764	8,338	20,887	8,833	3,882	6,498	2,116	1,960	5,567	2,250	1,536	1,472	519	504	279	134	70	253	95	60	321	119	106	417	214	43	1,520	484	277
Milwaukee	9,728	3,288	4,135	5,168	1,715	2,682	1,592	754	944	688	289	266	648	154	412	528	140	254	103	25	11	58	◆	41	89	35	◆	476	185	125
Minneapolis – St. Paul	2,100	1,014	603	1,076	597	281	428	180	154	279	116	99	159	54	105	16	◆	◆	◆	◆	◆	62	◆	31	17	◆	◆	81	41	◆
St. Louis	5,154	2,521	1,220	3,364	1,750	602	659	590	140	657	355	230	250	121	39	36	◆	23	36	16	◆	55	25	30	18	◆	◆	269	88	156
Kansas City – Tulsa	2,171	1,159	336	858	382	136	395	266	25	432	242	154	25	11	◆	101	85	◆	67	26	◆	143	86	21	67	55	◆	25	◆	◆
Dallas – Houston	2,624	1,187	417	1,259	664	133	399	129	63	290	42	98	31	◆	19	18	◆	◆	13	◆	◆	69	◆	24	◆	◆	◆	158	47	69
Denver	960	530	110	557	211	75	78	61	17	491	280	10	11	◆	◆	◆	◆	◆	21	◆	◆	15	◆	◆	◆	◆	◆	10	◆	◆
Seattle – Portland	811	293	324	446	190	176	86	47	35	295	16	78	28	13	13	◆	◆	◆	◆	◆	◆	20	17	◆	◆	◆	◆	35	◆	22
San Francisco	1,371	571	160	961	422	82	93	30	13	191	83	40	17	◆	◆	21	◆	◆	◆	◆	◆	29	◆	14	23	◆	◆	67	33	10
Los Angeles	7,565	3,322	951	4,255	1,866	253	1,267	605	129	881	335	19	304	152	48	129	43	◆	207	11	◆	61	25	◆	46	12	◆	545	283	57
TOTAL	240,583	92,238	67,119	123,394	51,583	29,107	41,383	14,534	14,659	35,312	12,137	11,128	10,330	4,044	3,286	5,466	1,989	1,529	2,090	627	329	2,205	743	981	3,569	1,697	616	16,834	4,984	5,496

Forging Machinery

	Total Units	10 Yrs & Over	Over 20 Yrs
Hammers, steam or air	3,934	84%	47%
Hammers, mechanical	5,708	88	53
Forging machines & rolls	6,079	75	33
Swaging machines	3,382	80	30
Other	1,199	51	28
Total	20,302	80	41

• – Less than 10

	TOTAL FORGING MACHINERY			HAMMERS, STEAM OR AIR			HAMMERS, MECHANICAL (INCL. DROP AND HELVE)			FORGING MACHINES (HEADERS) AND ROLLS			SWAGING MACHINES			OTHER FORGING MACHINERY		
	TOTAL	10-20 YEARS	OVER 20 YR	TOTAL	10-20 YEARS	OVER 20 YR	TOTAL	10-20 YEARS	OVER 20 YR	TOTAL	10-20 YEARS	OVER 20 YR	TOTAL	10-20 YEARS	OVER 20 YR	TOTAL	10-20 YEARS	OVER 20 YR
BY INDUSTRY																		
Farm Machinery	685	252	400	64	37	16	411	137	252	168	59	107	30	16	15	12	•	10
Const., Mining, Mat. Hdlg.	591	129	373	273	49	191	158	44	98	104	27	59	23	•	•	33	•	18
Metalworking Machinery	315	95	171	114	35	67	79	11	59	30	•	15	56	23	20	36	19	10
Special-Industry Machinery	502	156	199	94	49	40	161	48	99	26	•	10	58	14	30	163	39	20
General Industrial Equipment	600	259	205	72	14	47	154	37	81	294	188	51	59	14	18	21	•	•
Fabricated Metal Products	8,290	3,208	3,396	604	216	330	2,120	615	1,339	3,677	1,555	1,183	1,326	698	359	563	121	185
Office and Service Machines	300	195	58	19	•	13	201	167	30	31	20	11	49	•	•	•	•	•
Electrical Equipment	647	372	182	24	16	•	180	86	75	239	163	75	201	107	27	•	•	•
Household Appliances	85	42	•	•	•	•	•	•	•	•	•	•	71	35	•	•	•	•
Communications Equipment	106	13	19	•	•	•	58	•	•	22	•	•	17	•	•	•	•	•
Motor Vehicles and Parts	1,633	443	668	564	168	316	96	29	52	760	199	253	128	27	44	85	20	•
Complete Aircraft	462	277	•	102	80	•	191	119	•	33	18	•	63	34	•	73	26	•
Aircraft Engines, Props, Parts	681	478	22	131	69	•	345	238	16	28	15	•	177	156	•	•	•	•
Precision Mechanisms	469	141	266	•	•	•	37	13	20	12	•	•	395	121	221	16	•	14
Ordnance, Shipbuilding, Railroads	772	291	400	377	125	209	159	53	104	124	48	47	82	59	21	30	•	19
Forge Shops, Foundries, Misc.	4,164	1,584	1,871	1,477	584	579	1,350	386	810	529	202	191	647	378	243	161	34	48
Total	20,302	7,932	8,247	3,934	1,448	1,833	5,708	1,990	3,046	6,079	2,517	2,016	3,382	1,700	1,017	1,199	277	335
BY GEOGRAPHIC AREA																		
Boston	2,555	998	1,202	454	213	123	1,169	342	668	315	112	167	573	325	214	44	•	30
Bridgeport – Hartford	738	303	299	49	14	34	224	59	165	406	220	80	53	•	16	•	•	•
New York – Newark	1,270	607	410	216	82	58	354	116	190	315	206	30	354	202	103	31	•	29
Buffalo – Syracuse	970	364	389	65	29	15	322	99	198	155	11	107	288	186	69	140	39	•
Philadelphia – Camden	2,005	822	844	333	80	231	340	69	216	971	550	195	354	123	201	•	•	•
Pittsburgh – Wheeling	874	267	440	344	121	196	259	99	148	114	35	64	111	12	17	46	•	15
Baltimore	150	92	44	74	39	28	34	19	14	18	17	•	18	14	•	•	•	•
Richmond	276	75	88	71	26	34	90	•	20	113	45	32	•	•	•	•	•	•
Atlanta – New Orleans	372	114	199	134	49	72	71	46	16	102	13	74	49	•	24	16	•	13
Cleveland	2,108	794	1,011	493	209	218	245	45	195	1,023	372	523	87	49	29	260	119	46
Toledo	153	28	74	24	10	14	87	11	37	33	•	18	•	•	•	•	•	•
Cincinnati – Louisville	428	141	137	70	•	53	97	28	58	155	82	17	102	25	•	•	•	•
Detroit	1,597	444	665	421	77	283	163	24	99	784	278	236	127	30	23	102	35	24
Indianapolis	524	101	245	136	43	74	56	•	52	271	45	98	47	•	17	14	•	•
Chicago	2,858	1,361	867	256	111	90	692	347	314	690	332	147	876	545	235	344	26	81
Milwaukee	835	273	527	306	139	153	413	129	285	94	•	70	•	•	•	21	•	19
Minneapolis – St. Paul	227	65	142	30	14	12	138	44	95	16	•	16	43	•	19	•	•	•
St. Louis	277	145	110	24	19	•	130	90	32	71	18	52	28	10	13	24	•	13
Kansas City – Tulsa	186	118	57	62	25	29	43	21	20	16	•	•	65	64	•	•	•	•
Dallas – Houston	462	107	232	97	18	32	210	57	137	79	20	47	58	10	•	18	•	•
Denver	114	45	57	45	19	26	27	•	18	15	•	•	19	12	•	•	•	•
Seattle – Portland	125	37	63	46	20	18	43	•	31	23	•	•	•	•	•	13	•	•
San Francisco	163	96	46	24	•	11	71	54	14	29	21	•	•	•	•	31	10	21
Los Angeles	1,035	535	99	160	78	29	430	271	24	271	113	22	112	56	17	62	17	•
Total	20,302	7,932	8,247	3,934	1,448	1,833	5,708	1,990	3,046	6,079	2,517	2,016	3,382	1,700	1,017	1,199	277	335

Riveting Machines

	Total Units	10 Yrs & Over	Over 20 Yrs
Squeeze type	**21,621**	**49%**	**9%**
Rotary-vibrating type	**5,930**	**52**	**18**
Spinning type	**5,243**	**69**	**18**
Hammer type	**13,401**	**50**	**15**
Total riveting machines	**46,195**	**52**	**12**

• – Less than 10

	TOTAL RIVETING MACHINES			SQUEEZE TYPE			ROTARY-VIBRATING TYPE			SPINNING TYPE			HAMMER TYPE		
	TOTAL	10-20 YEARS	OVER 20 YR	TOTAL	10-20 YEARS	OVER 20 YR	TOTAL	10-20 YEARS	OVER 20 YR	TOTAL	10-20 YEARS	OVER 20 YR	TOTAL	10-20 YEARS	OVER 20 YR
BY INDUSTRY															
Farm Machinery	1,028	549	248	426	191	99	48	27	10	117	69	35	437	262	104
Const., Mining, Mat. Hdlg.	563	225	151	329	134	95	39	19	•	55	18	19	140	54	33
Metalworking Machinery	377	128	40	150	40	•	65	30	•	56	18	•	106	40	17
Special-Industry Machinery	496	192	120	134	53	10	145	33	62	106	50	29	111	56	19
General Industrial Equipment	1,033	518	188	378	190	46	127	66	40	88	28	11	440	234	91
Fabricated Metal Products	11,753	4,340	1,728	5,558	2,119	884	1,514	456	228	1,151	500	227	3,530	1,265	389
Office and Service Machines	3,329	1,135	948	855	424	111	1,052	294	408	650	247	228	772	170	201
Electrical Equipment	5,093	2,012	511	2,239	808	158	520	182	69	509	338	47	1,825	684	237
Household Appliances	1,313	534	142	827	351	48	132	67	23	72	29	•	282	77	62
Communications Equipment	3,939	1,273	207	1,747	459	17	721	287	30	280	88	143	1,191	439	17
Motor Vehicles and Parts	3,285	961	719	1,222	358	213	393	105	122	301	92	41	1,369	406	343
Complete Aircraft	3,114	1,971	16	2,661	1,729	15	44	21	•	31	10	•	378	211	•
Aircraft Engines, Props, Parts	2,227	772	46	1,594	381	11	157	127	•	185	107	12	291	157	14
Precision Mechanisms	2,765	1,017	276	1,191	537	107	614	160	22	406	148	89	554	172	58
Ordnance, Shipbuilding, Railroads	342	183	65	172	97	49	37	16	•	36	11	•	97	59	•
Forge Shops, Foundries, Misc.	5,538	2,490	309	2,138	790	48	322	144	43	1,200	908	71	1,878	648	147
Total	46,195	18,290	5,714	21,621	8,661	1,920	5,930	2,034	1,081	5,243	2,661	971	13,401	4,934	1,742
BY GEOGRAPHIC AREA															
Boston	3,271	1,663	395	1,287	827	107	349	94	44	720	366	140	915	376	104
Bridgeport – Hartford	2,871	1,244	533	960	329	89	672	288	178	803	423	204	436	204	62
New York – Newark	4,283	1,770	353	1,942	566	114	321	129	69	673	546	41	1,347	529	129
Buffalo – Syracuse	2,761	1,047	415	1,325	558	32	454	126	212	295	102	94	687	261	77
Philadelphia – Camden	2,640	937	389	1,053	322	104	624	272	29	209	98	37	754	245	139
Pittsburgh – Wheeling	1,480	637	298	910	341	203	85	49	•	49	34	•	356	213	93
Baltimore	639	264	53	474	204	31	31	17	•	44	19	18	90	24	•
Richmond	898	260	190	480	184	38	91	12	19	240	42	126	87	22	•
Atlanta – New Orleans	844	264	108	325	159	43	41	18	•	63	•	•	415	79	50
Cleveland	2,199	966	161	819	332	78	641	221	13	233	155	36	506	258	34
Toledo	809	132	77	196	33	30	84	10	•	151	57	11	378	32	33
Cincinnati – Louisville	2,371	878	572	674	259	115	497	75	218	220	53	75	980	491	164
Detroit	3,144	1,411	292	1,610	770	125	372	185	23	278	149	32	884	307	112
Indianapolis	1,498	477	215	532	158	55	248	78	42	61	17	12	657	224	106
Chicago	6,379	2,179	625	2,986	1,031	294	647	253	76	518	232	84	2,228	663	171
Milwaukee	1,544	605	449	553	209	179	165	52	45	156	65	29	670	279	196
Minneapolis – St. Paul	680	207	142	376	105	89	104	18	•	79	50	•	121	34	41
St. Louis	1,206	494	198	539	244	37	104	30	39	199	122	10	364	98	112
Kansas City – Tulsa	717	304	146	551	235	100	38	16	12	26	22	•	102	31	34
Dallas – Houston	895	282	47	442	100	19	75	17	17	18	•	•	360	158	11
Denver	255	110	30	89	36	•	•	•	•	22	14	•	137	56	30
Seattle – Portland	190	51	32	139	22	28	•	•	•	•	•	•	50	29	•
San Francisco	489	145	63	163	30	10	112	30	13	47	35	•	167	50	34
Los Angeles	4,212	1,963	11	3,196	1,607	•	167	40	•	139	45	•	710	271	•
Total	46,195	18,290	5,714	21,621	8,661	1,920	5,930	2,034	1,081	5,243	2,661	971	13,401	4,934	1,742

Punching and Shearing Machines

	TOTAL PUNCHING & SHEARING MACHINES			PUNCHING MACHINES (INCL. TURRET)			PLATE & SHEET SHEARS			BAR & ANGLE SHEARS			ROTARY SHEARS, INCL. SLITTERS			NIBBLING MACHINES			OTHER		
	TOTAL	10–20 PRICES	OVER 20 YR	TOTAL	10–20 PRICES	OVER 20 YR	TOTAL	10–20 PRICES	OVER 20 YR	TOTAL	10–20 PRICES	OVER 20 YR	TOTAL	10–20 PRICES	OVER 20 YR	TOTAL	10–20 PRICES	OVER 20 YR	TOTAL	10–20 PRICES	OVER 20 YR
BY INDUSTRY																					
Farm Machinery	2,167	907	600	556	280	177	742	272	171	437	189	139	159	69	44	112	51	14	161	46	55
Construction, Mining, Materials Handling	3,141	1,138	821	891	272	332	965	334	185	615	246	172	279	132	75	292	111	45	99	43	12
Metalworking Machinery	1,256	416	384	272	75	70	537	195	139	73	18	30	80	32	16	197	71	10	97	25	39
Special-Industry Machinery	2,248	860	729	628	233	312	767	295	196	251	96	71	197	95	65	315	122	58	90	19	27
General Industrial Equipment	2,098	884	626	498	233	188	784	355	192	217	81	65	295	108	112	258	102	63	46	•	•
Fabricated Metal Products	28,790	11,545	7,654	9,366	3,150	2,927	9,196	4,107	1,940	3,624	1,512	1,060	3,146	1,251	1,168	2,225	1,026	250	1,233	499	309
Office and Service Machines	3,530	1,302	722	875	316	206	1,697	600	354	213	93	34	268	121	43	384	153	67	93	19	18
Electrical Equipment	4,899	1,601	874	1,285	374	118	2,134	800	460	331	101	81	460	107	129	320	108	62	369	111	24
Household Appliances	1,083	470	271	222	118	67	686	264	154	44	23	10	80	29	21	101	32	•	30	•	10
Communications Equipment	2,044	535	119	749	157	65	850	263	45	41	11	•	52	•	•	243	46	•	109	52	•
Motor Vehicles and Parts	2,188	489	550	51	•	•	1,202	291	339	306	82	42	190	57	56	172	47	36	267	10	68
Complete Aircraft	1,265	703	21	195	104	•	715	360	13	48	27	•	60	32	•	149	110	•	98	70	•
Aircraft Engines, Propellers, and Parts	1,957	805	88	392	139	•	719	239	36	72	35	•	310	146	16	435	236	26	29	10	•
Precision Mechanisms	1,485	585	203	502	190	61	620	229	82	56	10	16	58	21	28	116	47	•	133	58	•
Ordnance, Shipbuilding, Railroads	3,539	1,837	1,088	1,181	524	473	1,428	855	330	353	131	159	230	130	67	192	88	25	155	109	34
Forge Shops, Foundries, Miscellaneous	8,815	3,640	1,731	1,409	698	227	3,349	1,463	537	678	240	220	639	289	116	555	224	98	1,385	726	533
TOTAL	69,705	27,687	16,401	19,072	6,865	5,236	26,311	10,922	5,173	7,359	2,895	2,103	6,503	2,625	1,960	6,066	2,574	777	4,394	1,806	1,152
BY GEOGRAPHIC AREA																					
Boston	4,378	1,871	1,335	915	458	267	1,322	445	291	370	165	95	306	154	69	332	132	51	1,133	517	562
Bridgeport – Hartford	1,450	535	347	346	151	61	662	208	198	87	15	21	94	35	26	215	115	23	46	11	18
New York – Newark	6,044	2,446	1,431	1,409	513	385	2,377	1,085	354	502	166	187	829	275	407	647	251	44	300	156	54
Buffalo – Syracuse	2,950	1,135	686	851	268	247	1,362	554	303	243	111	52	213	42	50	220	152	17	61	•	17
Philadelphia – Camden	4,353	1,881	1,106	1,201	530	376	1,615	690	363	477	276	128	401	165	146	426	122	66	233	98	27
Pittsburgh – Wheeling	3,038	946	1,205	960	300	483	1,180	390	291	352	134	137	352	65	231	139	45	46	55	12	17
Baltimore	1,169	484	309	298	144	76	486	209	85	112	38	19	149	27	99	64	38	14	60	28	16
Richmond	2,093	1,028	408	582	251	173	803	407	114	355	142	80	99	67	•	132	62	22	122	99	13
Atlanta – New Orleans	2,500	940	828	718	179	390	855	349	204	390	155	149	148	52	50	218	104	33	171	101	•
Cleveland	3,391	1,162	1,063	760	231	367	1,158	449	307	486	152	166	331	128	106	269	123	27	387	79	90
Toledo	715	239	174	169	19	76	297	135	37	65	34	17	61	19	17	102	26	27	21	•	•
Cincinnati – Louisville	3,513	1,389	930	823	257	327	1,417	602	349	294	117	74	408	174	75	403	144	95	168	95	10
Detroit	4,770	1,083	914	2,019	175	182	1,463	449	389	422	157	111	350	150	98	319	125	68	197	27	66
Indianapolis	1,486	554	370	230	64	88	757	305	167	151	55	37	134	80	31	65	35	•	149	15	39
Chicago	9,484	3,935	1,988	2,742	1,184	574	3,809	1,620	688	791	305	248	774	303	226	772	276	97	596	247	155
Milwaukee	2,442	965	790	548	131	246	992	424	269	317	121	133	274	135	102	257	127	39	54	27	•
Minneapolis – St. Paul	1,606	604	455	412	193	107	589	163	175	213	100	67	185	64	54	154	81	36	53	•	16
St. Louis	2,057	1,143	413	508	361	95	735	381	112	316	144	124	218	104	60	162	82	20	118	71	•
Kansas City – Tulsa	1,768	878	403	609	280	202	621	353	97	208	59	60	169	106	40	150	76	•	11	•	•
Dallas – Houston	2,536	924	285	863	330	143	894	291	74	355	139	52	142	69	•	241	67	•	41	28	•
Denver	959	509	270	344	175	125	289	158	59	105	47	36	112	71	25	51	28	•	58	30	21
Seattle – Portland	1,004	578	201	290	157	69	391	235	85	117	60	35	80	54	•	92	53	•	34	19	•
San Francisco	1,507	739	164	369	170	59	522	274	50	299	114	38	143	92	•	111	36	10	63	53	•
Los Angeles	4,472	1,719	326	1,106	344	118	1,715	746	112	332	89	37	531	194	23	525	274	18	263	72	18
TOTAL	69,705	27,687	16,401	19,072	6,865	5,236	26,311	10,922	5,173	7,359	2,895	2,103	6,503	2,625	1,960	6,066	2,574	777	4,394	1,806	1,152

	Total Units	10 Yrs & Over	Over 20 Yrs
Punching machines	19,072	63%	27%
Plate and sheet shears	26,311	61	20
Bar and angle shears	7,359	68	29
Rotary shears, incl slitters	6,503	70	30
Nibbling machines	6,066	55	13
Other	4,394	67	26
Total punching & shearing machines	69,705	63	24

• – Less than 10

Die Casting, Plastic Molding Machines

	Total Units	10 Yrs & Over	4% Over 20 Yrs
Hot-chamber die casters	2,563	32%	4%
Cold chamber	883	25	4
Total die casting machines	3,446	30	4
Injection molding machines	2,006	30	3
Compression	5,946	49	7
Extrusion	218	39	0
Total plastics molding machines	8,170	44	6

◆ – Less than 10

	TOTAL DIECASTING MACHINES			HOT CHAMBER			COLD CHAMBER			TOTAL PLASTICS MOLDING MACHINES			INJECTION MOLDING MACHINES			COMPRESSION MOLDING MACHINES			EXTRUSION MOLDING MACHINES		
	TOTAL	10-20 YEARS	OVER 20 YR	TOTAL	10-20 YEARS	OVER 20 YR	TOTAL	10-20 YEARS	OVER 20 YR	TOTAL	10-20 YEARS	OVER 20 YR	TOTAL	10-20 YEARS	OVER 20 YR	TOTAL	10-20 YEARS	OVER 20 YR	TOTAL	10-20 YEARS	OVER 20 YR
BY INDUSTRY																					
Farm Machinery	◆	◆	◆	◆	◆	◆	◆	◆	◆	◆	◆	◆	◆	◆	◆	◆	◆	◆	◆	◆	◆
Const., Mining, Mat. Hdlg.	◆	◆	◆	◆	◆	◆	◆	◆	◆	42	31	◆	◆	◆	◆	36	29	◆	◆	◆	◆
Metalworking Machinery	22	◆	10	22	◆	10	◆	◆	◆	300	108	114	102	47	◆	198	61	114	◆	◆	◆
Special-Industry Machinery	21	11	10	11	11	◆	10	◆	10	13	◆	◆	◆	◆	◆	◆	◆	◆	◆	◆	◆
General Industrial Equipment	36	◆	◆	17	◆	◆	19	◆	◆	23	20	◆	10	10	◆	13	10	◆	◆	◆	◆
Fabricated Metal Products	680	279	27	655	269	27	25	10	◆	652	323	43	316	132	23	292	191	20	44	◆	◆
Office and Service Machines	25	◆	◆	21	◆	◆	◆	◆	◆	192	52	◆	81	◆	◆	103	46	◆	◆	◆	◆
Electrical Equipment	688	153	42	544	110	32	144	43	10	3,797	1,605	208	330	79	◆	3,367	1,444	208	100	82	◆
Household Appliances	109	51	◆	99	48	◆	10	◆	◆	370	64	◆	50	28	◆	320	36	◆	◆	◆	◆
Communications Equipment	62	◆	◆	62	◆	◆	◆	◆	◆	1,229	385	79	440	97	41	751	288	38	38	◆	◆
Motor Vehicles and Parts	316	34	◆	210	◆	◆	106	25	◆	98	45	◆	39	23	◆	55	22	◆	◆	◆	◆
Complete Aircraft	◆	◆	◆	◆	◆	◆	◆	◆	◆	◆	◆	◆	◆	◆	◆	◆	◆	◆	◆	◆	◆
Aircraft Engines, Props, Parts	127	22	◆	45	22	◆	82	◆	◆	78	44	◆	30	◆	◆	48	37	◆	◆	◆	◆
Precision Mechanisms	12	◆	◆	◆	◆	◆	◆	◆	◆	552	106	15	206	29	◆	334	77	15	12	◆	◆
Ordnance, Shipbuilding, Railroads	15	◆	◆	15	◆	◆	◆	◆	◆	11	◆	◆	◆	◆	◆	◆	◆	◆	◆	◆	◆
Forge Shops, Foundries, Misc.	1,326	322	35	847	222	19	479	100	16	808	300	◆	393	76	◆	415	224	◆	◆	◆	◆
TOTAL	3,446	895	149	2,563	712	113	883	183	36	8,170	3,098	478	2,006	535	67	5,946	2,477	411	218	86	◆
BY GEOGRAPHIC AREA																					
Boston	138	12	◆	115	◆	◆	23	◆	◆	794	240	98	196	19	◆	530	166	98	60	55	◆
Bridgeport – Hartford	28	12	◆	28	12	◆	◆	◆	◆	901	426	39	101	35	◆	788	386	39	12	◆	◆
New York – Newark	181	76	◆	178	75	◆	◆	◆	◆	577	258	51	262	113	12	279	145	39	36	◆	◆
Buffalo – Syracuse	202	33	◆	190	27	◆	12	◆	◆	710	409	34	46	◆	◆	664	400	34	◆	◆	◆
Philadelphia – Camden	89	30	◆	89	30	◆	◆	◆	◆	837	431	28	107	27	28	702	380	◆	28	24	◆
Pittsburgh – Wheeling	47	◆	◆	27	◆	◆	20	◆	◆	400	194	◆	19	◆	◆	381	190	◆	◆	◆	◆
Baltimore	◆	◆	◆	◆	◆	◆	◆	◆	◆	29	15	◆	11	◆	◆	18	◆	◆	◆	◆	◆
Richmond	165	◆	◆	160	◆	◆	◆	◆	◆	28	12	◆	◆	◆	◆	24	12	◆	◆	◆	◆
Atlanta – New Orleans	46	◆	◆	14	◆	◆	32	◆	◆	188	17	◆	178	15	◆	10	◆	◆	◆	◆	◆
Cleveland	32	◆	◆	22	◆	◆	10	◆	◆	469	81	11	121	42	◆	334	39	11	14	◆	◆
Toledo	262	64	◆	211	63	◆	51	◆	◆	◆	◆	◆	◆	◆	◆	◆	◆	◆	◆	◆	◆
Cincinnati – Louisville	97	21	◆	87	19	◆	10	◆	◆	220	85	10	43	24	◆	177	61	◆	◆	◆	◆
Detroit	455	121	60	259	64	40	196	57	20	288	113	10	51	17	◆	233	96	10	◆	◆	◆
Indianapolis	338	81	◆	319	81	◆	19	◆	◆	526	112	54	199	42	◆	327	70	52	◆	◆	◆
Chicago	851	290	11	500	231	11	351	59	◆	1,219	447	137	415	107	23	791	340	114	13	◆	◆
Milwaukee	92	38	12	86	38	12	◆	◆	◆	80	17	◆	18	◆	◆	62	17	◆	◆	◆	◆
Minneapolis – St. Paul	23	13	◆	20	13	◆	◆	◆	◆	64	◆	◆	◆	◆	◆	59	◆	◆	◆	◆	◆
St. Louis	135	◆	10	104	◆	10	31	◆	◆	100	34	◆	83	24	◆	17	10	◆	◆	◆	◆
Kansas City – Tulsa	◆	◆	◆	◆	◆	◆	◆	◆	◆	94	59	◆	◆	◆	◆	88	54	◆	◆	◆	◆
Dallas – Houston	◆	◆	◆	◆	◆	◆	◆	◆	◆	19	◆	◆	◆	◆	◆	◆	◆	◆	11	◆	◆
Denver	16	10	◆	16	10	◆	◆	◆	◆	19	◆	◆	◆	◆	◆	10	◆	◆	◆	◆	◆
Seattle – Portland	50	37	◆	26	17	◆	24	20	◆	◆	◆	◆	◆	◆	◆	◆	◆	◆	◆	◆	◆
San Francisco	12	◆	10	◆	◆	◆	11	◆	10	130	14	◆	24	◆	◆	106	◆	◆	◆	◆	◆
Los Angeles	173	34	◆	97	10	◆	76	24	◆	470	117	◆	102	28	◆	330	89	◆	38	◆	◆
TOTAL	3,446	895	149	2,563	712	113	883	183	36	8,170	3,098	478	2,006	535	67	5,946	2,477	411	218	86	◆

Welding Equipment

	Total Units	10 Yrs & Over	Over 20 Yrs
Motor-generator sets	94,312	59%	6%
Transformers and rectifiers	83,159	30	2
Arc-weld machines	26,713	42	3
Spot welders	65,071	47	9
Gun welders	5,581	36	5
Seam welders	3,132	50	6

• – Less than 10

	TOTAL WELDING EQUIPMENT			TOTAL ELECTRIC WELDING EQUIPMENT			MOTOR-GENERATOR SETS			TRANSFORMERS AND RECTIFIERS			ARC-WELD MACHINES			SPOT WELDERS		
	TOTAL	10-20 YEARS	OVER 20 YR	TOTAL	10-20 YEARS	OVER 20 YR	TOTAL	10-20 YEARS	OVER 20 YR	TOTAL	10-20 YEARS	OVER 20 YR	TOTAL	10-20 YEARS	OVER 20 YR	TOTAL	10-20 YEARS	OVER 20 YR
BY INDUSTRY																		
Farm Machinery	8,053	3,432	525	7,774	3,283	518	2,694	1,342	194	2,848	1,110	41	945	234	56	986	482	171
Const., Mining, Mat. Hdlg.	20,997	7,301	615	19,399	6,617	548	7,039	3,497	289	9,794	2,226	127	1,807	522	69	602	302	60
Metalworking Machinery	5,411	2,138	359	4,783	1,910	317	1,631	800	120	1,484	476	40	785	326	38	659	234	79
Special-Industry Machinery	8,324	3,656	380	7,593	3,329	349	3,808	1,879	153	1,868	565	•	809	347	13	849	399	131
General Industrial Equipment	11,330	4,465	836	10,576	4,121	793	3,553	1,904	437	4,558	1,218	80	931	344	38	1,234	492	210
Fabricated Metal Products	112,755	50,741	5,900	105,503	47,643	5,681	39,240	21,982	1,809	30,212	9,875	462	9,837	3,740	220	21,233	10,155	2,436
Office and Service Machines	9,767	3,693	905	9,452	3,592	875	3,258	1,420	242	1,307	285	32	790	162	73	3,395	1,491	515
Electrical Equipment	14,044	5,254	1,443	13,532	5,035	1,394	3,046	1,372	400	3,054	977	252	998	288	86	5,395	2,031	556
Household Appliances	6,190	2,314	371	6,129	2,296	370	955	293	42	396	174	11	527	120	69	3,238	1,286	205
Communications Equipment	7,443	1,159	147	7,328	1,137	146	684	193	38	938	143	•	200	58	15	5,292	710	84
Motor Vehicles and Parts	34,906	7,936	1,604	34,283	7,729	1,542	7,680	3,285	793	12,693	1,865	27	2,511	648	89	9,693	1,438	505
Complete Aircraft	2,584	1,273	•	2,499	1,252	•	1,010	579	•	613	260	•	201	76	•	418	218	•
Aircraft Engines, Props, Parts	9,877	2,832	138	9,652	2,749	134	3,348	1,245	75	1,962	372	•	1,074	398	•	2,249	458	39
Precision Mechanisms	3,858	1,756	231	3,673	1,663	220	550	287	30	883	337	79	317	202	•	1,683	737	99
Ordnance, Shipbuilding, Railroads	22,973	12,802	845	21,290	11,696	777	9,926	6,808	602	6,741	2,309	64	3,309	2,050	14	509	270	42
Forge Shops, Foundries, Misc.	21,199	10,193	1,094	20,128	9,710	1,056	5,890	3,242	243	3,808	1,286	78	1,672	788	20	7,636	3,936	644
TOTAL	299,711	120,945	15,393	283,594	113,762	14,720	94,312	50,128	5,467	83,159	23,478	1,313	26,713	10,298	810	65,071	24,639	5,776
BY GEOGRAPHIC AREA																		
Boston	14,304	5,048	1,769	13,587	4,668	1,704	2,971	1,750	383	2,661	900	168	1,365	517	65	5,792	1,230	945
Bridgeport – Hartford	3,769	1,814	320	3,561	1,733	306	1,073	639	71	648	311	13	336	139	•	1,259	562	183
New York – Newark	21,534	9,187	1,346	20,448	8,723	1,282	5,820	3,564	508	5,840	1,812	182	2,398	1,200	51	5,829	1,965	451
Buffalo – Syracuse	11,481	5,432	765	10,992	5,208	737	4,094	2,663	228	2,162	823	42	1,131	326	60	2,798	1,107	368
Philadelphia – Camden	22,545	11,644	518	21,454	11,197	493	5,595	3,477	219	6,607	2,417	32	2,175	1,119	32	6,171	3,975	166
Pittsburgh – Wheeling	14,471	7,911	433	13,377	7,307	408	5,304	3,342	146	5,208	2,626	61	1,122	518	18	1,257	635	130
Baltimore	3,003	1,730	179	2,869	1,647	166	1,597	848	104	572	361	13	177	115	•	522	268	37
Richmond	8,015	3,376	240	7,243	2,939	213	2,594	1,704	106	1,901	201	16	1,388	548	•	992	372	47
Atlanta – New Orleans	14,530	8,981	183	13,627	5,617	183	6,951	3,931	40	3,472	438	36	1,215	326	•	1,599	711	96
Cleveland	14,566	5,284	1,195	13,709	4,910	1,155	4,297	2,107	447	3,721	694	177	1,539	568	16	3,300	1,246	395
Toledo	3,711	1,739	95	3,550	1,674	93	1,500	1,021	51	854	308	•	253	106	14	835	204	23
Cincinnati – Louisville	14,580	5,634	1,128	13,983	5,352	1,076	4,833	2,464	375	3,998	1,084	65	1,066	373	51	3,810	1,173	524
Detroit	26,699	7,212	2,488	25,528	6,831	2,393	7,702	3,114	1,065	8,697	1,071	107	2,021	543	114	5,535	1,697	712
Indianapolis	6,981	2,979	420	6,815	2,929	409	1,566	674	179	1,417	615	20	477	156	30	2,691	1,166	169
Chicago	44,618	16,420	1,948	42,669	15,584	1,876	13,929	5,980	711	11,696	3,589	79	3,151	1,132	91	11,158	3,979	925
Milwaukee	13,267	4,731	640	12,493	4,401	621	3,496	1,694	205	6,092	1,449	92	827	206	63	1,670	835	221
Minneapolis – St. Paul	6,222	2,564	120	5,887	2,384	110	1,632	1,009	49	2,342	675	•	350	135	•	1,390	492	30
St. Louis	7,096	3,466	253	6,691	3,267	248	2,545	1,451	72	1,597	515	13	300	146	•	1,707	804	95
Kansas City – Tulsa	7,647	3,311	262	7,088	2,981	247	2,231	1,443	65	2,786	806	78	443	115	•	1,385	514	84
Dallas – Houston	11,013	3,630	309	10,214	3,409	263	3,696	1,921	117	3,820	964	30	1,117	149	65	1,284	297	23
Denver	3,883	2,009	173	3,611	1,860	151	1,518	483	90	882	451	26	888	741	26	265	149	•
Seattle - Portland	4,689	2,863	195	4,326	2,570	190	1,838	1,418	40	1,121	477	•	915	499	52	263	108	66
San Francisco	7,918	1,967	111	7,182	1,720	103	2,788	921	51	2,382	243	17	1,039	314	11	810	176	21
Los Angeles	13,179	5,013	383	12,690	4,851	293	4,832	2,510	145	3,083	648	37	1,020	307	13	2,749	974	56
TOTAL	299,711	120,445	15,393	283,594	113,762	14,720	94,312	50,128	5,467	83,159	23,478	1,313	26,713	10,298	810	65,071	24,639	5,776

	Total Units	10 Yrs & Over	Over 20 Yrs
Butt and flash welders	5,626	54%	2%
Total electric welding equipment	283,594	45	5
Gas welding machines	3,357	40	4
Flame cutting machines	12,760	51	4
Total welding equipment	299,711	45	5

* – Less than 10

GUN WELDERS			SEAM WELDERS			BUTT & FLASH WELDERS			GAS WELDING MACHINES			FLAME CUTTING MACHINES			
TOTAL	10-20 YEARS	OVER 20 YR	TOTAL	10-20 YEARS	OVER 20 YR	TOTAL	10-20 YEARS	OVER 20 YR	TOTAL	10-20 YEARS	OVER 20 YR	TOTAL	10-20 YEARS	OVER 20 YR	
															BY INDUSTRY
90	36	*	80	36	12	131	43	44	74	49	*	205	100	*	Farm Machinery
59	13	*	17	*	*	81	48	*	85	49	*	1,513	635	59	Const., Mining, Mat. Hdlg.
20	*	*	26	*	*	178	58	38	173	65	*	455	163	39	Metalworking Machinery
69	51	*	61	*	24	129	79	20	201	96	*	530	231	22	Special-Industry Machinery
77	28	15	54	27	*	169	108	13	128	86	*	626	258	41	General Industrial Equipment
1,496	356	232	863	467	32	2,622	1,068	490	1,276	305	39	5,976	2,793	180	Fabricated Metal Products
456	116	*	202	106	*	44	12	*	100	45	12	215	56	18	Office and Service Machines
73	*	*	295	104	38	671	267	62	157	95	*	355	124	49	Electrical Equipment
624	272	16	264	128	21	125	23	*	50	17	*	11	*	*	Household Appliances
*	*	*	24	11	*	181	22	*	96	16	*	19	*	*	Communications Equipment
982	287	22	255	74	46	469	132	60	324	77	48	299	130	14	Motor Vehicles and Parts
64	35	*	106	34	*	87	50	*	25	*	*	60	17	*	Complete Aircraft
275	16	*	594	224	*	150	36	12	82	45	*	143	38	*	Aircraft Engines, Props, Parts
110	50	*	43	12	*	87	38	*	105	55	*	80	38	*	Precision Mechanisms
658	202	*	67	28	14	80	29	34	162	54	*	1,521	1,052	67	Ordnance, Shipbuilding, Railroads
519	202	11	181	91	*	422	165	54	319	158	*	752	325	32	Forge Shops, Foundries, Misc.
5,981	1,673	307	3,132	1,368	197	5,626	2,178	850	3,357	1,216	131	12,760	5,967	542	TOTAL
															BY GEOGRAPHIC AREA
196	49	*	187	101	13	415	121	129	180	45	12	537	335	53	Boston
30	*	*	39	14	*	176	63	28	69	2	*	139	79	14	Bridgeford – Hartford
135	36	*	132	92	*	294	54	89	369	156	*	707	308	57	New York – Newark
209	52	*	148	61	*	450	176	33	70	30	16	419	194	12	Buffalo – Syracuse
526	106	*	69	17	19	311	86	24	185	47	*	906	400	23	Philadelphia – Camden
89	33	*	80	33	*	317	120	52	83	31	*	1,011	573	25	Pittsburgh – Wheeling
36	27	*	24	15	*	31	13	*	57	48	*	77	35	12	Baltimore
248	72	*	44	*	*	76	38	31	146	68	*	626	369	27	Richmond
178	95	*	123	61	*	89	55	*	143	56	*	760	308	*	Atlanta – New Orleans
236	72	*	128	32	25	488	191	89	140	78	*	717	296	40	Cleveland
41	*	*	20	12	*	47	22	*	26	*	*	135	63	*	Toledo
239	88	24	251	103	19	186	67	18	46	22	*	551	260	50	Cincinnati – Louisville
635	108	226	228	64	42	710	234	127	451	108	65	720	273	30	Detroit
404	214	*	107	47	*	153	57	*	33	*	*	133	45	*	Indianapolis
1,232	296	*	738	306	*	765	302	61	430	105	*	1,519	731	68	Chicago
209	110	13	106	57	*	93	50	20	178	65	*	596	265	15	Milwaukee
84	40	*	53	12	21	36	21	*	78	49	*	257	131	*	Minneapolis – St. Paul
150	92	*	117	96	*	275	163	51	105	63	*	300	136	*	St. Louis
41	*	*	157	90	*	45	12	*	45	22	*	514	308	11	Kansas City – Tulsa
143	13	*	36	*	*	118	57	28	151	71	*	648	150	46	Dallas – Houston
15	*	*	12	*	*	31	23	*	53	36	*	219	113	22	Denver
138	37	15	25	*	13	26	26	*	29	21	*	334	272	*	Seattle – Portland
104	31	*	32	15	*	27	20	*	158	44	*	578	203	*	San Francisco
263	89	*	276	116	*	467	207	39	132	42	*	357	120	*	Los Angeles
5,581	1,673	307	3,132	1,368	197	5,626	2,178	850	3,357	1,216	131	12,760	5,967	542	TOTAL

Heating Equipment

	Total Units	10 Yrs & Over	Over 20 Yrs
Heat-treating furnaces	42,592	61%	15%
Atmosphere generators	3,657	37	9
Stock-heating furnaces	11,879	60	21
Salt baths	8,664	55	10
Induction heating units	7,944	26	2
Baking and drying ovens	22,382	42	8
Flame-hardening units	1,906	47	10
Total heating equipment	99,024	52	12

• – Less than 10

	TOTAL HEATING EQUIPMENT			HEAT-TREATING FURNACES			ATMOSPHERE GENERATORS			STOCK-HEATING FURNACES			SALT BATHS			INDUCTION HEATING UNITS			BAKING & DRYING OVENS			FLAME-HARDENING UNITS		
	TOTAL	10-20 YEARS	OVER 20 YR	TOTAL	10-20 YEARS	OVER 20 YR	TOTAL	10-20 YEARS	OVER 20 YR	TOTAL	10-20 YEARS	OVER 20 YR	TOTAL	10-20 YEARS	OVER 20 YR	TOTAL	10-20 YEARS	OVER 20 YR	TOTAL	10-20 YEARS	OVER 20 YR	TOTAL	10-20 YEARS	OVER 20 YR
BY INDUSTRY																								
Farm Machinery	2,951	1,415	533	1,050	499	140	81	60	•	1,060	529	302	247	121	24	237	95	•	219	90	40	69	21	20
Constr., Mining, Mat. Hdlg.	3,017	1,170	429	1,505	599	240	150	13	•	444	201	141	252	123	•	280	57	11	264	104	25	172	73	•
Metalworking Machinery	6,617	3,266	882	4,146	2,278	682	235	78	•	208	74	41	1,001	454	67	442	150	•	379	116	70	286	108	14
Special-Industry Machinery	2,405	1,164	375	1,377	781	288	62	32	•	211	102	70	331	184	14	116	35	•	213	68	19	95	42	10
General Industrial Equipment	7,055	2,011	998	3,745	1,597	680	449	143	•	670	288	133	467	230	82	867	161	35	717	288	94	140	43	72
Fabricated Metal Products	10,024	7,417	2,551	8,544	4,617	1,267	784	267	21	1,363	880	496	1,442	612	213	1,670	296	•	3,803	1,294	454	418	151	72
Office and Service Machines	2,616	1,839	257	1,185	477	142	85	15	•	130	73	11	280	125	24	252	98	•	737	243	59	17	•	•
Electrical Equipment	8,721	2,825	604	2,558	988	331	189	28	•	619	225	71	538	253	63	506	97	•	4,216	1,208	356	85	•	•
Household Appliances	1,475	703	156	461	241	38	32	•	•	47	23	•	135	59	12	225	143	•	584	220	97	•	•	•
Communications Equipment	6,047	912	119	1,448	338	24	87	•	•	860	124	22	183	49	22	1,082	122	26	2,337	276	25	10	•	•
Motor Vehicles and Parts	8,500	2,491	1,304	3,956	1,527	860	225	26	•	1,552	575	270	990	250	185	966	241	30	1,077	234	32	166	29	•
Complete Aircraft	772	353	11	315	135	•	49	17	•	66	34	•	99	69	•	35	11	•	105	67	•	43	20	•
Aircraft Engines, Props, Parts	6,123	2,726	302	3,073	1,617	52	414	96	•	267	61	15	432	213	32	497	104	•	1,371	608	•	89	27	•
Precision Mechanisms	4,772	1,468	421	1,468	593	235	159	38	15	82	20	11	553	236	36	597	76	•	1,971	418	112	122	52	21
Ordnance, Shipbuilding, Railroads	5,316	2,804	1,142	2,320	1,348	525	26	•	•	673	371	313	303	156	26	298	123	•	1,449	758	247	85	22	25
Forge Shops, Foundries, Misc.	14,180	6,649	2,150	5,453	2,680	980	712	215	288	2,877	1,310	605	1,470	782	68	602	131	•	2,980	1,468	233	180	94	11
TOTAL	99,024	39,148	12,318	42,592	19,524	6,391	3,657	1,025	334	11,879	4,681	2,508	8,664	3,889	851	7,944	1,948	159	22,382	7,468	1,876	1,906	693	199
BY GEOGRAPHIC AREA																								
Boston	7,827	3,468	1,368	3,915	2,010	682	206	43	•	739	308	293	711	421	95	627	88	11	1,450	538	250	171	50	33
Bridgeport – Hartford	4,208	1,676	632	1,890	844	305	282	80	22	323	99	94	492	282	49	413	109	38	583	132	38	225	130	35
New York – Newark	8,824	3,708	819	3,876	2,605	413	261	127	•	470	199	84	661	260	90	729	195	•	2,552	846	282	275	121	28
Buffalo – Syracuse	4,829	1,929	623	2,205	996	315	73	12	•	368	139	126	383	155	65	333	130	•	1,362	475	83	95	21	31
Philadelphia – Camden	5,417	2,256	627	2,498	1,148	367	178	47	•	764	470	159	390	159	54	510	40	•	972	348	99	115	24	10
Pittsburgh – Wheeling	5,272	2,081	673	2,888	982	295	141	37	•	1,402	655	221	229	133	21	160	53	•	1,146	373	133	36	•	•
Baltimore	1,428	680	301	417	215	89	20	11	•	220	113	32	63	37	•	73	25	•	635	266	172	•	•	•
Richmond	2,280	808	200	861	437	139	16	•	•	185	54	•	137	47	•	75	20	•	1,200	242	61	34	•	•
Atlanta – New Orleans	1,962	916	210	735	395	60	59	41	•	280	210	60	106	49	11	151	33	•	886	196	74	46	32	•
Cleveland	6,424	2,592	863	2,770	1,280	429	165	37	•	829	206	155	635	174	64	427	71	22	1,522	795	177	86	23	•
Toledo	1,705	699	147	649	322	88	42	31	•	304	59	56	98	61	•	355	53	•	181	49	15	62	34	•
Cincinnati – Louisville	3,368	1,432	397	1,475	662	260	61	15	•	271	116	25	497	175	29	276	140	•	882	280	67	76	35	11
Detroit	9,153	3,220	1,467	4,298	1,929	839	447	125	•	1,500	364	342	947	318	122	760	148	23	963	299	122	102	26	•
Indianapolis	5,041	2,360	517	2,816	980	294	360	18	•	658	275	115	1,236	671	73	380	97	•	585	219	26	66	40	•
Chicago	13,060	4,933	1,614	5,799	2,314	997	879	275	302	1,507	774	85	612	305	75	1,158	320	•	2,615	807	168	190	58	•
Milwaukee	3,764	1,370	798	1,496	611	246	179	50	•	759	253	396	187	49	35	331	179	15	745	217	72	58	11	20
Minneapolis – St. Paul	1,264	435	93	364	128	22	34	11	•	180	91	64	305	56	•	80	•	•	567	125	15	14	•	•
St. Louis	1,863	880	194	611	312	105	30	•	•	167	101	11	206	100	10	252	82	•	556	200	67	21	•	•
Kansas City – Tulsa	1,112	533	53	370	226	35	27	•	•	73	49	•	84	69	•	198	24	•	336	146	•	30	18	•
Dallas – Houston	1,786	488	287	795	294	124	122	24	•	203	65	108	97	18	•	137	23	•	489	77	43	23	11	•
Denver	675	411	127	322	178	54	18	•	•	153	89	35	115	78	•	46	16	•	195	87	33	17	•	•
Seattle – Portland	646	388	94	493	238	71	•	•	•	17	•	•	27	15	•	•	•	•	102	102	15	10	•	•
San Francisco	1,494	664	150	561	298	91	15	•	•	202	72	29	85	36	26	66	12	•	522	263	•	23	•	•
Los Angeles	5,488	1,537	60	2,213	826	40	210	10	•	227	57	•	465	220	•	699	80	•	1,823	297	•	71	29	•
TOTAL	99,024	39,148	12,318	42,592	19,524	6,391	3,657	1,025	334	11,879	4,681	2,508	8,664	3,889	851	7,944	1,948	159	22,382	7,468	1,876	1,906	693	199

Cleaning and Finishing Equipment

	Total Units	10 Yrs & Over	Over 20 Yrs
Barrel finishing machines	26,704	56%	21%
Shot and abrasive blast	12,417	49	7
Parts washing machines	24,135	38	5
Pickling machines	1,854	48	7
Total cleaning equipment	65,110	48	12
Plating machines	7,616	39	7
Plating barrels	8,259	50	5
Total plating equipment	15,875	44	6

◆ – Less than 10

	TOTAL CLEANING EQUIPMENT			BARREL FINISHING MACHINES			SHOT & ABRASIVE BLAST			PARTS WASHING MACHINES			PICKLING MACHINES			TOTAL PLATING EQUIPMENT			MACHINES			BARRELS		
	TOTAL	10-20 YEARS	OVER 20 YR	TOTAL	10-20 YEARS	OVER 20 YR	TOTAL	10-20 YEARS	OVER 20 YR	TOTAL	10-20 YEARS	OVER 20 YR	TOTAL	10-20 YEARS	OVER 20 YR	TOTAL	10-20 YEARS	OVER 20 YR	TOTAL	10-20 YEARS	OVER 20 YR	TOTAL	10-20 YEARS	OVER 20 YR
BY INDUSTRY																								
Farm Machinery	1,321	598	288	374	138	125	408	149	76	521	205	87	18	◆	◆	102	57	◆	58	35	◆	44	22	◆
Const., Mining, Mat. Hdlg.	1,834	754	130	312	113	51	504	236	27	999	379	52	19	◆	◆	137	33	◆	76	24	◆	61	◆	◆
Metalworking Machinery	2,321	775	160	697	180	54	814	313	91	791	283	15	19	◆	◆	320	142	15	252	122	◆	68	20	12
Special-Industry Machinery	1,530	441	232	766	163	176	332	129	25	394	135	31	28	14	◆	328	144	111	202	125	68	66	19	43
General Industrial Equipment	4,820	1,898	499	1,908	707	255	870	369	82	1,983	705	157	59	27	◆	291	99	27	224	65	27	67	34	◆
Fabricated Metal Products	14,179	5,051	2,428	6,817	2,149	1,956	1,975	829	178	4,629	1,834	242	758	240	52	4,046	1,564	195	1,226	390	118	2,820	1,174	77
Office and Service Machines	2,191	777	457	1,024	303	378	183	59	15	914	366	64	70	49	◆	765	247	163	334	103	18	431	144	145
Electrical Equipment	4,528	1,519	386	1,882	693	270	648	162	45	1,920	599	59	158	65	12	1,713	612	79	831	226	55	882	386	24
Household Appliances	1,479	597	166	666	194	105	169	79	◆	549	187	28	95	47	25	235	155	24	201	127	24	34	28	◆
Communications Equipment	2,276	599	91	871	294	55	223	39	20	1,131	246	16	51	20	◆	1,261	357	25	657	91	15	604	266	10
Motor Vehicles and Parts	5,364	1,026	359	603	149	53	946	227	25	3,668	594	275	87	36	◆	606	207	32	493	130	32	113	77	◆
Complete Aircraft	617	310	◆	187	74	◆	80	33	◆	287	173	◆	54	30	◆	139	65	10	57	28	◆	82	37	10
Aircraft Engines, Props, Parts	3,736	1,376	25	1,265	489	11	838	384	◆	1,501	441	◆	132	62	◆	911	508	◆	589	417	◆	312	91	◆
Precision Mechanisms	3,256	1,238	307	1,500	645	198	454	162	69	1,261	431	36	41	◆	◆	706	320	33	245	150	11	461	170	22
Ordnance, Shipbuilding, Railroads	3,014	1,905	195	344	182	21	1,380	1,080	41	1,206	638	126	76	55	◆	456	58	18	348	26	◆	108	32	11
Forge Shops, Foundries, Misc.	12,684	4,521	2,307	7,588	2,670	1,989	2,575	983	222	2,382	769	77	189	99	19	3,859	1,598	189	1,753	415	118	2,106	1,183	71
TOTAL	65,110	23,091	8,030	26,704	9,163	5,697	12,417	5,182	929	24,135	7,985	1,274	1,854	761	130	15,875	6,166	923	7,616	2,474	498	8,259	3,692	425
BY GEOGRAPHIC AREA																								
Boston	5,817	2,541	835	3,100	1,370	626	817	323	158	1,812	796	40	80	52	11	1,574	839	95	619	258	90	955	581	◆
Bridgeport – Hartford	4,774	1,502	624	3,209	929	527	386	157	39	1,129	404	47	50	12	11	1,227	490	181	321	89	36	906	401	145
New York – Newark	6,958	3,033	485	3,649	1,623	314	1,010	584	47	2,128	741	124	171	85	◆	2,334	1,220	100	1,024	485	76	1,310	735	24
Buffalo – Syracuse	3,074	1,087	318	1,280	540	170	554	223	52	1,159	392	87	81	22	◆	546	153	◆	274	46	◆	272	107	◆
Philadelphia – Camden	3,635	1,264	888	1,973	552	808	529	240	30	1,040	410	47	93	62	◆	1,015	455	156	435	189	109	580	286	47
Pittsburgh – Wheeling	1,379	544	96	390	225	62	415	143	17	562	137	11	72	35	◆	251	87	19	69	26	19	182	61	◆
Baltimore	874	479	111	122	61	◆	216	126	12	491	259	92	45	33	◆	111	41	◆	65	27	◆	46	14	◆
Richmond	1,335	668	35	426	168	35	368	261	◆	514	218	◆	27	21	◆	490	34	◆	293	◆	◆	197	28	◆
Atlanta – New Orleans	1,511	626	190	497	130	157	601	338	19	358	117	14	55	41	◆	211	53	◆	137	37	◆	74	16	◆
Cleveland	3,456	915	832	1,462	280	683	681	249	55	1,206	336	64	107	50	30	748	454	33	335	199	25	413	255	◆
Toledo	1,230	427	94	428	194	61	181	50	14	603	176	19	18	◆	◆	206	117	◆	153	105	◆	55	12	◆
Cincinnati – Louisville	2,431	846	289	779	234	285	530	222	28	1,038	352	56	84	38	◆	613	280	45	308	115	16	305	165	29
Detroit	7,460	2,012	1,426	2,815	705	1,062	1,457	406	109	2,925	736	227	263	105	◆	852	290	104	639	218	84	213	72	20
Indianapolis	2,045	726	193	611	258	108	477	181	32	877	249	56	80	38	◆	309	126	30	320	98	22	49	28	◆
Chicago	8,708	3,092	625	2,569	967	264	1,656	653	161	4,328	1,429	179	155	43	21	1,965	752	92	735	303	◆	1,230	449	86
Milwaukee	2,048	724	266	647	256	94	620	245	76	722	211	78	59	12	18	376	245	◆	95	49	◆	281	196	◆
Minneapolis – St. Paul	712	162	42	198	43	22	117	69	13	286	50	◆	196	◆	◆	150	58	◆	72	31	◆	78	27	◆
St. Louis	985	316	84	253	68	52	235	65	13	414	178	15	13	◆	◆	1,202	159	20	854	67	◆	348	92	20
Kansas City – Tulsa	736	431	43	284	168	34	108	61	◆	322	197	◆	22	◆	◆	75	27	◆	42	◆	◆	33	19	◆
Dallas – Houston	1,047	228	84	411	78	49	307	68	20	311	77	15	18	◆	◆	264	40	17	152	23	◆	112	17	17
Denver	544	247	75	105	53	◆	94	59	14	336	135	52	◆	◆	◆	89	13	◆	28	◆	◆	61	◆	◆
Seattle – Portland	403	202	16	53	13	◆	197	133	◆	141	49	◆	12	◆	◆	80	◆	◆	66	◆	◆	14	◆	◆
San Francisco	555	250	15	171	98	◆	181	108	◆	161	40	◆	42	◆	◆	422	79	◆	240	12	◆	182	67	◆
Los Angeles	3,483	709	363	1,269	150	331	680	217	◆	1,412	386	30	102	16	◆	703	153	◆	340	98	◆	363	55	◆
TOTAL	65,110	23,091	8,030	26,704	9,163	5,697	12,417	5,182	929	24,135	7,985	1,274	1,854	761	130	15,875	6,166	923	7,616	2,474	498	8,259	3,692	425

Industrial Trucks, Other Shop Equipment

	Total Units	10 Yrs & Over	Over 20 Yrs
Lift (rider) trucks	46,212	33%	3%
Truck-tractors	9,412	26	3
Powered hand trucks	22,618	36	5
Crane trucks	4,653	24	8
Total industrial trucks	82,895	34	4
Balancing machines	7,624	43	9
Air compressors	49,959	48	8
Gear-checking machines	6,749	39	9

• – Less than 10

	TOTAL INDUSTRIAL TRUCKS			LIFT (RIDER-TYPE)			TRUCK-TRACTOR			POWERED HAND TRUCKS			CRANE TRUCKS			BALANCING MACHINES			AIR COMPRESSORS			GEAR-CHECKING MACHINES		
	TOTAL	10-20 YEARS	OVER 20 YR	TOTAL	10-20 YEARS	OVER 20 YR	TOTAL	10-20 YEARS	OVER 20 YR	TOTAL	10-20 YEARS	OVER 20 YR	TOTAL	10-20 YEARS	OVER 20 YR	TOTAL	10-20 YEARS	OVER 20 YR	TOTAL	10-20 YEARS	OVER 20 YR	TOTAL	10-20 YEARS	OVER 20 YR
BY INDUSTRY																								
Farm Machinery	4,180	1,780	220	2,432	910	217	442	223	•	1,174	587	•	132	63	•	218	80	13	1,125	586	172	407	183	74
Const., Mining, Mat. Hdlg.	4,545	1,843	126	2,601	655	50	388	186	12	1,887	161	22	429	121	42	228	61	21	1,941	780	205	244	103	24
Metalworking Machinery	2,833	960	70	1,841	590	21	297	120	22	600	190	19	105	80	•	312	112	11	2,899	1,140	201	1,171	483	172
Special-Industry Machinery	2,103	693	107	1,181	361	48	282	52	38	473	172	10	167	58	11	449	159	63	2,009	969	199	154	58	27
General Industrial Equipment	4,255	1,567	40	2,576	733	20	411	105	•	1,111	362	•	157	66	11	889	354	70	2,649	1,106	233	1,697	619	174
Fabricated Metal Products	20,541	6,646	820	12,000	4,210	503	2,070	456	36	4,403	1,421	227	1,468	578	54	591	161	34	16,413	6,588	1,454	38	•	•
Office and Service Machines	5,080	1,687	283	2,305	731	56	535	131	126	2,082	685	82	140	60	19	318	175	•	1,039	644	134	47	19	•
Electrical Equipment	5,214	1,532	109	2,567	880	34	811	277	30	1,722	620	44	94	35	•	1,163	485	80	3,442	1,100	171	175	41	•
Household Appliances	2,074	545	32	1,308	443	20	148	25	•	590	77	•	27	•	•	249	50	56	704	305	68	51	38	•
Communications Equipment	1,594	222	16	982	131	10	123	•	•	466	82	•	23	•	•	46	•	•	1,799	488	51	59	21	•
Motor Vehicles and Parts	9,395	1,614	480	4,402	922	150	1,767	289	26	2,823	415	145	493	68	79	1,747	295	224	1,395	392	152	1,473	300	222
Complete Aircraft	2,468	435	•	1,423	242	•	575	95	•	364	65	•	112	30	•	67	19	•	659	131	•	38	•	•
Aircraft Engines, Props, Parts	3,225	789	•	1,705	488	•	398	48	•	960	233	•	102	24	•	458	176	11	2,159	825	16	789	302	12
Precision Mechanisms	1,155	257	13	733	196	12	37	10	•	374	79	•	11	•	•	172	69	•	1,858	739	43	230	76	•
Ordnance, Shipbuilding, Railroads	6,781	2,823	716	1,873	493	70	711	201	19	3,380	1,674	540	817	455	79	241	120	19	1,133	602	116	183	93	16
Forge Shops, Foundries, Misc.	7,202	2,538	432	5,252	1,841	315	423	82	12	1,319	523	35	398	92	70	466	227	32	8,265	3,278	980	104	13	•
TOTAL	82,895	24,784	3,383	46,212	13,766	1,526	9,412	2,158	330	22,618	7,146	1,133	4,653	1,714	394	7,624	2,571	684	49,959	19,758	4,184	6,749	2,384	765
BY GEOGRAPHIC AREA																								
Boston	2,964	888	154	1,824	603	96	285	46	28	513	251	19	129	58	11	588	245	80	3,107	1,204	237	382	117	54
Bridgeport – Hartford	1,679	575	75	1,017	312	56	195	59	14	426	192	•	67	12	•	193	62	12	1,571	689	109	389	70	22
New York – Newark	4,510	1,438	82	2,585	775	16	648	116	17	1,066	451	10	221	96	19	740	295	38	5,319	2,035	294	423	196	17
Buffalo – Syracuse	3,921	1,321	186	2,340	835	77	536	196	•	930	347	11	115	43	16	692	206	60	1,780	644	255	383	103	•
Philadelphia – Camden	4,527	1,381	164	2,424	783	95	568	158	23	1,228	575	•	287	75	42	221	71	20	2,595	1,145	194	186	60	19
Pittsburgh – Wheeling	2,693	903	56	1,791	675	44	223	57	•	544	135	•	130	36	•	287	68	11	2,011	842	260	29	21	•
Baltimore	2,974	1,318	440	765	322	23	218	78	17	1,066	747	339	325	171	61	20	•	•	922	264	20	128	36	13
Richmond	2,216	775	182	640	110	•	220	41	•	1,096	695	180	310	125	•	133	59	•	1,173	398	57	28	10	•
Atlanta – New Orleans	2,532	810	84	1,629	550	55	386	112	•	323	79	•	194	90	•	371	102	43	1,721	767	191	51	30	•
Cleveland	4,961	1,541	152	3,008	1,017	120	503	115	20	1,215	537	•	153	52	12	469	126	•	2,501	1,101	257	532	233	79
Toledo	1,518	481	36	880	322	22	288	67	•	366	57	12	55	35	•	187	27	•	728	369	60	287	38	•
Cincinnati – Louisville	5,364	1,667	336	2,118	961	62	617	121	120	2,419	882	113	200	73	41	434	164	27	2,075	873	225	301	100	50
Detroit	7,822	2,698	673	4,303	1,122	272	905	287	36	2,150	576	388	363	103	56	1,144	224	236	3,437	1,203	182	1,370	491	168
Indianapolis	2,731	747	69	1,510	487	35	225	44	•	836	237	27	156	59	•	278	89	17	1,090	324	157	476	140	71
Chicago	12,995	3,710	413	8,201	2,440	313	790	295	22	3,573	867	80	431	107	18	882	385	47	7,804	3,059	778	1,804	641	176
Milwaukee	4,052	1,570	130	2,474	810	130	344	128	•	972	336	•	282	96	•	446	155	48	2,145	957	230	653	184	64
Minneapolis – St. Paul	974	172	14	680	121	14	88	26	•	166	•	•	70	22	•	89	32	•	961	392	80	60	16	•
St. Louis	2,335	824	111	1,279	448	56	235	69	•	731	307	35	90	19	20	176	71	•	1,342	722	188	39	23	•
Kansas City – Tulsa	1,101	371	16	858	275	•	243	37	•	200	44	•	90	15	16	71	25	•	965	343	98	•	•	•
Dallas – Houston	2,824	648	14	1,375	287	•	927	73	•	285	28	•	236	60	•	86	18	•	1,719	582	75	60	•	•
Denver	1,335	686	59	457	187	31	116	44	12	573	350	•	189	105	•	55	17	•	470	198	37	66	22	•
Seattle – Portland	562	180	•	385	111	•	24	•	•	44	14	•	111	55	•	36	17	•	485	249	45	•	•	•
San Francisco	1,367	378	19	708	222	•	205	13	•	156	28	•	237	115	14	69	36	•	708	404	41	53	28	•
Los Angeles	4,598	784	34	3,061	981	15	575	56	•	720	68	•	252	70	19	287	67	•	3,808	1,084	95	255	85	•
TOTAL	82,895	24,784	3,383	46,212	13,766	1,526	9,412	2,158	330	22,618	7,146	1,133	4,653	1,714	394	7,624	2,571	684	49,959	19,758	4,184	6,749	2,384	765

One-Fourth of Nation's Machine Tools Are Outside Metalworking; 63% of These Are at Least 10 Years Old

Twenty-five per cent of the nation's machine tools are located outside the metalworking industries. Average age distribution of an estimated 559,000 units in this category is slightly higher than in Metalworking: 63% are at least 10 years old and 26% are over 20 years old.

These machine tools are found in maintenance shops of non-metalworking industries, in production lines of some of these industries, and in training institutions. The estimate includes all machine tools outside Metalworking, except those in storage or in the hands of builders and distributors. (For a breakdown of total U. S. machine tools, see page 10.)

Machine Tools in Maintenance

Omitting figures for training institutions from the above calculations leaves an estimated 490,000 machine tools in maintenance operations of non-metalworking industries. 61% of these machines are at least 10 years old. This age distribution is only 1% above Metalworking's at-least-10-years-old average for machine tools. But where 18% of machine tools in Metalworking are over 20 years old, machine tools used in maintenance plants average 26% in the same age group. **Both Metalworking and non-metalworking have roughly the same percentage of over-age machines, but the percentage of really obsolete machines is substantially greater in the latter.**

Maintenance figures include machine tools used in the following:

- Non-metalworking industries: public utilities, food, textile, tobacco, apparel, wood furniture, leather, stone, clay, glass, paper, printing, chemical, petroleum and coal, rubber, primary metal, and mining, lumbering and construction.
- Railroad maintenance shops.
- Air-transport maintenance for scheduled air lines and contract aircraft-maintenance firms.

Tables giving totals for up to 167 types of equipment used in these three maintenance groups appear on pages 91 through 93.

Railroad Maintenance Units Decline

Since the last Inventory in 1953, there has been a substantial drop in the number of machine tools in railroad maintenance shops. Today these shops have a total of 19,700 machine tools (metal-cutting and metal-forming types); five years ago the total was 32,500. Today 83% of the total are at least 10 years old, compared to 81% in 1953. Percentage of units more than 20 years old has declined since 1953 from 65% to 54%.

The decline in machine tools used for railroad maintenance continues the trend noted in 1953, when totals were down compared with the previous Inventory of 1949. Responsible for part of this decline is the gradual elimination of steam operations on the railroads. The need to maintain extensive maintenance facilities for both steam and diesel operations no longer is so great as formerly.

A large part of the decline in railroad-maintenance facilities can be attributed to the decline of railroad operations in general. One measure of this is in the equipment found in the industry that makes locomotives, cars, and other equipment for the railroads. In 1953, plants in the railroad-equipment industry had a total of 23,000 machine tools. Today there are 8,800 machine tools in the same industry. (See page 35 for figures on this industry, which has been incorporated with figures for the ordnance and shipbuilding industries.)

The railroad-maintenance average of 83% of machine tools at least 10 years old makes its equipment the oldest, on the average, of any group included in this Inventory—either within Metalworking or outside it.

Air Transport Maintenance Rises

The decline in railroad-maintenance equipment is in striking contrast to the gains in air-maintenance equipment during the past five years. In 1953 there were 2,780 machine tools in the maintenance shops of air lines and contract aircraft maintenance firms. Today there are 4,200 units.

Although aircraft maintenance has expanded considerably, equipment is considerably older, on the average, than in 1953. Much new equipment has been added in the past five years, but the trend to obsolescence is obvious. Average age, however, is still considerably younger than in most industries. Today 46% of machine tools are at least 10 years old and 3% are more than 20 years old. In

MACHINE TOOLS IN MAINTENANCE AND TRAINING

	TOTAL MACHINE TOOLS			METAL-CUTTING MACHINE TOOLS			METAL-FORMING MACHINE TOOLS		
	Estimated Units	10 yrs & over	Over 20 yrs.	Estimated Units	10 yrs & over	Over 20 yrs	Estimated Units	10 yrs & over	Over 20 yrs
General Maintenance	466,000	60%	25%	332,000	62%	26%	134,000	57%	22%
Air Transport	4,200	46	3	2,900	49	4	1,300	39	3
Railroad Maintenance	19,700	83	54	15,000	82	50	4,700	85	68
Colleges and Vocational Institutes	9,900	83	17	9,000	84	17	900	79	11
High Schools	59,200	75	24	56,000	76	24	3,200	66	21
Estimated Totals	559,000	63	26	414,900	65	26	144,100	56	23

OTHER EQUIPMENT IN MAINTENANCE AND TRAINING

	WELDING EQUIPMENT			HEATING EQUIPMENT			CLEANING & FINISHING			INDUSTRIAL TRUCKS		
	Estimated Units	10 yrs & over	Over 20 yrs	Estimated Units	10 yrs & over	Over 20 yrs	Estimated Units	10 yrs & over	Over 20 yrs	Estimated Units	10 yrs & over	Over 20 yrs
General Maintenance	97,000	41%	9%	41,000	44%	20%	16,500	66%	34%	82,000	33%	7%
Air Transport	220	33	0	210	24	0	640	18	0	310	45	1
Railroad Maintenance	5,300	67	26	1,320	80	55	440	26	6	3,570	56	18
Colleges & Vocational Institutes	1,400	77	6	640	48	8	80	63	12	80	88	10
High Schools	8,000	67	10	1,650	67	29	130	70	46	80	75	0
Estimated Totals	111,920	45	9	44,820	46	21	17,790	63	37	86,040	34	7

1953 percentages were 36% and 3% in these age classifications.

Air-transport maintenance equipment, interestingly enough, is not as old on the average as machine tools in two related metalworking industries: In aircraft assembly plants, 51% of machine tools are at least 10 years old; machine tools in plants that make aircraft engines, propellers, and parts average 50% at least 10 years old.

General Maintenance Holds Its Own

The majority of machine tools outside Metalworking are found in the industries referred to earlier as non-metalworking industries. Five years ago there were an estimated 455,000 machine tools here; today there are 466,000. Figures for these industries appear in the General Maintenance table on page 91.

There has been a slight improvement in the age distribution of equipment in general maintenance use since 1953. Today 60% of machine tools are at least 10 years old, compared to 61% five years ago. And these industries have been discarding old machines at a healthy rate: Today only 26% are more than 20 years old, compared with 31% in 1953.

Age distribution of 60% at least 10 years old in non-metalworking industries is exactly the same as in Metalworking. But there are substantially larger numbers of machine tools more than 20 years old being used for maintenance in plants outside Metalworking: 26%, or more than one-fourth of total machine tools, are over 20 years old here. Percentage for metalworking industries is 18% over 20 years old.

Modernization of metal-forming machine tools actually has been more extensive outside Metalworking than within it. In 1953, 64% of metal-forming units in non-metalworking maintenance use were at least 10 years old. Only 57% today are in this category. This 7% shift toward modernization is in contrast to the trend within metalworking industries, where percentage of metal-forming units at least 10 years old increased between 1953 and 1958 from 58% to 62%.

Equipment Other Than Machine Tools

The table on this page gives figures on equipment other than metal-cutting and metal-forming machine tools in maintenance use outside Metalworking. As in machine tools, average age of this equipment in railroad-maintenance shops is older than in air-transport and general maintenance shops. As might be expected, average age of this equipment is lower in air-transport maintenance than in the other two maintenance groups.

How does the age distribution of this equipment compare with that in the metalworking industries? The answer is that it is remarkably similar, with the exception of cleaning and finishing equipment. Here are the percentages of equipment at least 10 years old for both Metalworking and non-metalworking:

	MW	non-MW
Welding	46%	45%
Heating	52%	46%
Cleaning & Finishing	47%	63%
Industrial Trucks	34%	34%

College Equipment Obsolete

There are an estimated 9,900 machine tools in U. S. colleges and vocational institutes, and most of these are obsolete. 83% are at least 10 years old, and 17% are more than 20 years old. Five years ago only 53% of these units were at least 10 years old. And in the 1949 Inventory only 26% fell into this age classification.

The cause for this phenomenal increase is not hard to find. War-surplus machine tools, distributed to training institutes at the end of World War II, are still in use and in most cases have not been replaced. Although the percentage of machine tools over 20 years old is only 17%, one can predict a sharp rise here when the next Inventory is taken in 1963.

Equipment other than machine tools also is aging rapidly. 88% of industrial trucks are at least 10 years old. Welding equipment averages 77% at least 10 years old, and 63% of cleaning and finishing equipment falls into this category.

High School Coverage Added

The new Inventory includes for the first time information on machine tools and other equipment located in U. S. high schools. Although equipment used in high-school training courses is in somewhat better condition, from the standpoint of age, than that in colleges and vocational institutes, there is still much obsolete machinery: 75% of machine tools are at least 10 years old, and 24% of the total are more than 20 years old.

The table for high schools (on page 95) includes reports from the following states: Alabama, Idaho, Illinois, Kansas, Maine, Maryland, Massachusetts, Michigan, Missouri, Nebraska, Nevada, New Jersey, Oklahoma, Oregon, Pennsylvania, South Carolina, South Dakota, Tennessee, Utah, Vermont, and West Virginia. These states were able to furnish complete, or near-complete, reports on metalworking equipment in their high schools. A few other states sent in partial reports.

Returns from these states, representing approximately one-third of the machine tools in the nation's high schools, show that much of the training equipment in use is outdated. As with college equipment, a great part of equipment is surplus machinery distributed after World War II.

Can high school students adequately learn their trade by training with obsolete machine tools? There is no clear-cut answer to this question, just as there is no black-and-white solution to many of the problems in education today. This report shows that three out of four machine tools in high schools are obsolescent. An extensive modernization program is needed if the country's training facilities are to match those of industry in general.

	Reported Units	10 yrs & over	Over 20 yrs
METAL CUTTING	5,090	62%	26%
METAL FORMING	2,664	57	22
OTHER EQUIPMENT	3,871	42	12
TOTAL	11,625	54	21

• – Less than 10

This table contains reports from the following non-metalworking industries: public utilities, mining, lumbering, construction, food, textile, tobacco, apparel, wood furniture, leather, stone, clay, glass, paper, printing, chemical, petroleum and coal, rubber, and primary metal. Published figures represent an estimated 1½% of total equipment.

	TOTAL	10-20 YEARS	OVER 20 YR
METAL-CUTTING MACHINES	5,090	1,802	1,333
Boring Machines	145	54	43
Horizontal boring, drilling, & milling	22	•	•
Vertical boring mills incl vert turret lathes	65	21	30
Precision, horizontal and vertical	14	•	•
Jig boring, horizontal and vertical	43	18	•
Other (except boring lathes)	•	•	•
Broaching Machines	19	•	•
Horizontal internal or combination	•	•	•
Horizontal surface	•	•	•
Vertical internal	•	•	•
Vertical surface or combination	•	•	•
Continuous horizontal & vertical	•	•	•
Other (incl rotary surface)			
Contour Sawing and Filing	62	21	•
Cutoff Machines	549	195	116
Bandsaw (incl friction)	171	67	18
Abrasive disk	48	12	11
Hacksaws	202	65	54
Circular (incl friction)	86	40	25
Other	43	11	•
Drilling Machines	847	308	214
Sensitive	134	67	36
Upright: Single-spindle	429	139	85
Gang	47	20	19
Radial	124	44	44
Multi-spindle cluster, adjustable and fixed center	28	•	•
Automatic	•	•	•
Unit head & way type (not dial)	•	•	•
Deep-hole drills	•	•	•
Other (not incl special machines)	72	24	20
Gear Cutting and Finishing Machines	43	15	22
Hobbing machines, gear	•	•	•
Shapers, gear	•	•	•
Form-milling type (spur and bevel)	•	•	•
Bevel-gear cutters (not planer)	•	•	•
Grinders, gear tooth	18	11	•
Shavers, gear tooth	•	•	•
Burnishing and lapping	•	•	•
Chamfering, tooth pointing, tooth rounding	•	•	•
Other	•	•	•
Grinding Machines	1,230	428	303
External cylindrical: Plain	32	10	•
Universal	54	17	17
Internal cylindrical	18	•	•
Centerless: External	27	•	•
Internal	•	•	•
Surface: Rotary-table type	100	52	15
Reciprocating type	123	37	20
Disk, horizontal and vertical	59	20	19
Tool and cutter (incl drill)	175	88	28
Bench, floorstand, and snag	517	154	156
Jig grinders	•	•	•
Contour grinders	15	•	•
Abrasive belt (not polishing)	46	•	10
Other (except thread grinders)	53	19	12
Honing and Lapping	72	•	11
Honing: Internal (incl combination)	16	•	•
External and surface	•	•	•
Lapping: Surface	34	•	•
Cylindrical	•	•	•
Other (incl combination hone-lap)	13	•	•
Lathes	986	375	309
Bench, floor, lt-dy (incl turret attachment)	234	97	60
Engine, heavy-duty: Standard	425	144	152
Toolroom	100	29	25
Manufacturing and gap	11	•	•
Tracer	18	•	•
Turret lathes: Ram type	75	37	25
Saddle type	38	16	14
Auto chucking & between centers (single spindle)	26	•	16
Automatic chucking (multi-spindle)	59	27	•
Automatic screw machines (single spindle)	•	•	•
Automatic bar machines (multi-spindle)	•	•	•
Other (except spinning lathes)	23	•	11
Milling Machines	414	171	109
Bench type	21	•	•
Hand	37	10	13
Knee-type: Horizontal (plain & universal)	205	86	56
Vertical	107	49	21
Automatic & manufacturing	•	•	•
Ram type, swivel head	13	•	•
Bed (Lincoln) type, incl automatic rise and fall	•	•	•
Planer type (incl skin and spar)	•	•	•
Profilers, duplicators, diesinkers, engravers	17	•	•
Other (except thread milling)	•	•	•
Planers	49	14	26
Double housing	23	•	17
Openside and other	26	•	•
Pipe Cutting and Threading Machines	179	53	37
Polishing and Buffing Machines	173	47	29
Polishing stands (bench and floor)	90	18	•
Speed lathes	15	•	•
Abrasive-belt, disk, drum	53	20	•
Other	15	•	•
Shapers	231	86	81
Horizontal	170	68	67
Vertical, incl slotters & keyseaters	45	18	14
Threading (except pipe)	54	11	21
Tapping	27	•	•
Hobbing and milling	•	•	•
Die type	16	•	•
Grinders, thread	•	•	•
Rolling machines, thread	•	•	•
Other	•	•	•

	TOTAL	10-20 YEARS	OVER 20 YR
Electro-Erosion Machines (exc Tap disintegrators)	•	•	•
Ultrasonic Cutting Machines	•	•	•
Special Multi-Station Machines	•	•	•
In-line and transfer	•	•	•
Dial or rotary table	•	•	•
Automatic assembly (all types)	•	•	•
Other Metal-Cutting Machines	43	•	•
METAL-FORMING MACHINES	2,664	930	597
Bending and Forming Machines (Power)	162	56	47
Bending rolls, sheet and plate	34	•	15
Bending rolls, bars and shapes	11	•	•
Bending brakes	54	21	11
Rotary bending and forming machines	22	•	•
Bending machines, pipe, bar, and shapes	41	19	11
Wire and Strip Forming Machines	57	22	•
Hydraulic Presses	947	418	220
Vertical, single-action	396	99	78
Vertical, double and triple action	89	17	27
Horizontal	16	•	11
Extrusion (from hot billets)	•	•	•
Other (incl stretch and hydro-pneumatic)	442	297	104
Pneumatic Presses (except hydro-pneumatic)	•	•	•
Mechanical Presses (Power)	753	194	141
Inclinable, single-action (incl inclined)	554	126	74
Vertical, single-action: Straight-side (incl arch)	62	20	15
Vertical, single-action: Gap or C-frame	26	10	10
Vertical, single-action: Adjust. bed and horning	20	•	•
Double and triple action	•	•	•
Dieing machines	18	•	•
Horizontal (incl bulldozers)	•	•	•
Multiple transfer (incl eyeletting)	51	17	32
Other	•	•	•
Punching and Shearing Machines	263	83	120
Punching machines (incl turret)	38	•	25
Plate and sheet shears	104	20	52
Bar and angle shears	46		27
Rotary shears, incl slitters	29	•	•
Nibbling machines	12	•	•
Other	34	11	•
Forging Machinery (except presses)	103	21	53
Hammers, steam or air	21	•	19
Hammers, mechanical (incl drop and helve)	13	•	•
Forging machines (headers) and rolls	19	•	13
Swaging machines	49	12	12
Other	•	•	•
Riveting Machines (not portable)	26	•	•
Squeeze type	13	•	•
Rotary-vibrating type	•	•	•
Spinning type	•	•	•
Hammer type	•	•	•
Die Casting Machines	•	•	•
Hot chamber	•	•	•
Cold chamber	•	•	•
Plastics Molding Machines	340	162	•
Injection	120	36	•
Compression	195	124	•
Extrusion	25	•	•
WELDING EQUIPMENT	1,390	454	122
Electric Welding Equipment	1,339	432	116
Power source: Motor-generator set	210	105	28
Transformer and rectifier	192	69	•
Arc-weld machines (not hand) incl automatic	328	77	14
Resistance welders: Spot	318	136	37
Gun (not hand)	•	•	•
Seam	10	•	•
Butt and flash	277	39	28
Gas Welding Machines (not hand)	12	•	•
Flame Cutting Machines (not hand)	39	16	•
HEATING EQUIPMENT	587	141	115
Heat-treating furnaces	225	63	53
Atmosphere generators	•	•	•
Stock-heating furnaces	39	•	•
Salt baths	17	•	•
Induction heating units	54	•	•
Baking and drying ovens	242	48	44
Flame-hardening units	•	•	•
CLEANING AND FINISHING	235	74	80
Cleaning Equipment	206	63	68
Barrel finishing machines	106	27	56
Shot and abrasive blast	30	12	•
Parts washing machines (incl degreasers)	67	22	•
Pickling machines	•	•	•
Plating Equipment	29	11	12
Machines	16	11	•
Barrels	13	•	10
INDUSTRIAL TRUCKS (Power-Driven)	1,175	301	88
Lift (rider-type)	749	174	43
Truck-tractor	172	57	23
Powered hand trucks	224	56	18
Crane trucks	30	14	•
OTHER SHOP EQUIPMENT	474	192	67
Balancing Machines	20	•	•
Air Compressors	433	167	66
Gear-Checking Machines	21	20	•

Air Transport Maintenance

Data in this table have been expanded to represent approximate total holdings of equipment in maintenance shops of scheduled air lines and contract aircraft maintenance firms in the United States.

	Total Units	10 yrs & over	Over 20 yrs
METAL CUTTING	2,917	49%	4%
METAL FORMING	1,306	39	3
OTHER EQUIPMENT	1,544	28	0
TOTAL	5,767	41	3

◆ – Less than 10

	TOTAL	10-20 YEARS	OVER 20 YR
METAL-CUTTING MACHINES	2,917	1,333	107
Boring Machines	60	20	◆
Horizontal boring, drilling, & milling	27	14	◆
Vertical boring mills incl vert turret lathes	22	◆	◆
Precision, horizontal and vertical	◆	◆	◆
Jig boring, horizontal and vertical	◆	◆	◆
Other (except boring lathes)	◆	◆	◆
Broaching Machines	◆	◆	◆
Horizontal internal or combination	◆	◆	◆
Horizontal surface	◆	◆	◆
Vertical internal	◆	◆	◆
Vertical surface or combination	◆	◆	◆
Continuous horizontal & vertical	◆	◆	◆
Other (incl rotary surface)	54	32	◆
Contour Sawing and Filing	264	97	◆
Cutoff Machines	165	59	◆
Bandsaw (incl friction)	35	11	◆
Abrasive disk	43	16	◆
Hacksaws	16	11	◆
Circular (incl friction)	◆	◆	◆
Other	652	316	24
Drilling Machines	81	68	◆
Sensitive	443	213	24
Upright: Single-spindle	◆	◆	◆
Gang	92	27	◆
Radial	11	◆	◆
Multi-spindle cluster, adjustable and fixed center	◆	◆	◆
Automatic	◆	◆	◆
Unit head & way type (not dial)	◆	◆	◆
Deep-hole drills	19	◆	◆
Other (not incl special machines)	◆	◆	◆
Gear Cutting and Finishing Machines	◆	◆	◆
Hobbing machines, gear	◆	◆	◆
Shapers, gear	◆	◆	◆
Form-milling type (spur and bevel)	◆	◆	◆
Bevel-gear cutters (not planer)	◆	◆	◆
Grinders, gear tooth	◆	◆	◆
Shavers, gear tooth	◆	◆	◆
Burnishing and lapping	◆	◆	◆
Chamfering, tooth pointing, tooth rounding	◆	◆	◆
Other	853	351	33
Grinding Machines	14	◆	◆
External cylindrical: Plain	43	24	◆
Universal	24	14	◆
Internal cylindrical	14	◆	◆
Centerless: External	11	◆	◆
Internal	35	22	◆
Surface: Rotary-table type	16	◆	◆
Reciprocating type	◆	◆	◆
Disk, horizontal and vertical	70	19	◆
Tool and cutter (incl drill)	451	173	◆
Bench, floorstand, and snag	◆	◆	◆
Jig grinders	◆	◆	◆
Contour grinders	140	65	22
Abrasive belt (not polishing)	22	◆	◆
Other (except thread grinders)	127	62	◆
Honing and Lapping	59	32	◆
Honing: Internal (incl combination)	◆	◆	◆
External and surface	30	◆	◆
Lapping: Surface	16	16	◆
Cylindrical	14	11	◆
Other (incl combination hone-lap)	396	232	35
Lathes	113	68	◆
Bench, floor, ll-dy (incl turret attachment)	151	78	22
Engine, heavy-duty: Standard	51	27	◆
Toolroom	11	◆	◆
Manufacturing and gap	◆	◆	◆
Tracer	27	19	◆
Turret lathes: Ram type	◆	◆	◆
Saddle type	◆	◆	◆
Auto chucking & between centers (single spindle)	◆	◆	◆
Automatic chucking (multi-spindle)	◆	◆	◆
Automatic screw machines (single spindle)	◆	◆	◆
Automatic bar machines (multi-spindle)	32	32	◆
Other (except spinning lathes)	94	40	◆
Milling Machines	◆	◆	◆
Bench type	22	◆	◆
Hand	32	22	◆
Knee-type: Horizontal (plain & universal)	28	◆	◆
Vertical	◆	◆	◆
Automatic & manufacturing	◆	◆	◆
Ram type, swivel head	◆	◆	◆
Bed (Lincoln) type, incl automatic rise and fall	◆	◆	◆
Planer type (incl skin and spar)	◆	◆	◆
Profilers, duplicators, diesinkers, engravers	◆	◆	◆
Other (except thread milling)	◆	◆	◆
Planers	◆	◆	◆
Double housing	◆	◆	◆
Openside and other	◆	◆	◆
Pipe Cutting and Threading Machines	351	155	◆
Polishing and Buffing Machines	65	49	◆
Polishing stands (bench and floor)	57	38	◆
Speed lathes	194	57	◆
Abrasive-belt, disk, drum	35	11	◆
Other	24	◆	◆
Shapers	24	◆	◆
Horizontal	◆	◆	◆
Vertical, incl slotters & keyseaters	14	◆	◆
Threading (except pipe)	◆	◆	◆
Tapping	◆	◆	◆
Hobbing and milling	◆	◆	◆
Die type	◆	◆	◆
Grinders, thread	◆	◆	◆
Rolling machines, thread	11	◆	◆
Other			

	TOTAL	10-20 YEARS	OVER 20 YR
Electro-Erosion Machines (exc Tap disintegrators)	◆	◆	◆
Ultrasonic Cutting Machines	◆	◆	◆
Special Multi-Station Machines	◆	◆	◆
In-line and transfer	◆	◆	◆
Dial or rotary table	◆	◆	◆
Automatic assembly (all types)	◆	◆	◆
Other Metal-Cutting Machines	14	14	◆
METAL-FORMING MACHINES	1,306	468	38
Bending and Forming Machines (Power)	244	144	◆
Bending rolls, sheet and plate	65	49	◆
Bending rolls, bars and shapes	22	◆	◆
Bending brakes	111	68	◆
Rotary bending and forming machines	◆	◆	◆
Bending machines, pipe, bar, and shapes	43	19	◆
Wire and Strip Forming Machines	◆	◆	◆
Hydraulic Presses	182	51	◆
Vertical, single-action	92	51	◆
Vertical, double and triple action	◆	◆	◆
Horizontal	◆	◆	◆
Extrusion (from hot billets)	◆	◆	◆
Other (incl stretch and hydro-pneumatic)	◆	◆	◆
Pneumatic Presses (except hydro-pneumatic)	32	18	◆
Mechanical Presses (Power)	◆	◆	◆
Inclinable, single-action (incl inclined)	11	◆	◆
Vertical, single-action: Straight-side (incl arch)	11	◆	◆
Vertical, single-action: Gap or C-frame	◆	◆	◆
Vertical, single-action: Adjust. bed and horning	◆	◆	◆
Double and triple action	◆	◆	◆
Dieing machines	◆	◆	◆
Horizontal (incl bulldozers)	◆	◆	◆
Multiple transfer (incl eyeletting)	◆	◆	◆
Other	241	81	11
Punching and Shearing Machines	49	19	◆
Punching machines (incl turret)	132	38	◆
Plate and sheet shears	◆	◆	◆
Bar and angle shears	◆	◆	◆
Rotary shears, incl slitters	11	◆	◆
Nibbling machines	41	14	◆
Other	38	14	◆
Forging Machinery (except presses)	◆	◆	◆
Hammers, steam or air	16	11	◆
Hammers, mechanical (incl drop and helve)	◆	◆	◆
Forging machines (headers) and rolls	19	◆	◆
Swaging machines	◆	◆	◆
Other	432	154	◆
Riveting Machines (not portable)	351	78	◆
Squeeze type	◆	◆	◆
Rotary-vibrating type	◆	◆	◆
Spinning type	275	73	◆
Hammer type	◆	◆	◆
Die Casting Machines	◆	◆	◆
Hot chamber	◆	◆	◆
Cold chamber	◆	◆	◆
Plastics Molding Machines	◆	◆	◆
Injection	◆	◆	◆
Compression	◆	◆	◆
Extrusion	◆	◆	◆
WELDING EQUIPMENT	217	73	◆
Electric Welding Equipment	209	62	◆
Power source: Motor-generator set	57	35	◆
Transformer and rectifier	57	◆	◆
Arc-weld machines (not hand) incl automatic	54	◆	◆
Resistance welders: Spot	32	11	◆
Gun (not hand)	◆	◆	◆
Seam	◆	◆	◆
Butt and flash	◆	◆	◆
Gas Welding Machines (not hand)	14	11	◆
Flame Cutting Machines (not hand)	◆	◆	◆
HEATING EQUIPMENT	208	50	◆
Heat-treating furnaces	119	19	◆
Atmosphere generators	◆	◆	◆
Stock-heating furnaces	◆	◆	◆
Salt baths	16	14	◆
Induction heating units	◆	◆	◆
Baking and drying ovens	59	14	◆
Flame-hardening units	◆	◆	◆
CLEANING AND FINISHING	637	114	◆
Cleaning Equipment	432	76	◆
Barrel finishing machines	16	◆	◆
Shot and abrasive blast	122	41	◆
Parts washing machines (incl degreasers)	275	24	◆
Pickling machines	19	11	◆
Plating Equipment	205	38	◆
Machines	170	14	◆
Barrels	35	24	◆
INDUSTRIAL TRUCKS (Power-Driven)	308	137	◆
Lift (rider-type)	208	105	◆
Truck-tractor	62	27	◆
Powered hand trucks	11	◆	◆
Crane trucks	27	◆	◆
OTHER SHOP EQUIPMENT	174	46	◆
Balancing Machines	22	◆	◆
Air Compressors	149	43	◆
Gear-Checking Machines	◆	◆	◆

	Total Units	10 yrs & over	Over 20 yrs
METAL CUTTING	15,168	82%	50%
METAL FORMING	4,680	85	68
OTHER EQUIPMENT	12,232	63	24
TOTAL	32,080	75	43

• – Less than 10

Data in this table have been expanded to represent approximate total holdings of equipment in maintenance shops of railroads in the United States.

	TOTAL	10-20 YEARS	OVER 20 YR
METAL-CUTTING MACHINES	15,168	4,862	7,610
Boring Machines	695	202	380
Horizontal boring, drilling, & milling	175	49	106
Vertical boring mills incl vert turret lathes	456	141	255
Precision, horizontal and vertical	11	•	•
Jig boring, horizontal and vertical	•	•	•
Other (except boring lathes)	53	•	11
Broaching Machines	23	•	•
Horizontal internal or combination	•	•	•
Horizontal surface	11	•	•
Vertical internal	•	•	•
Vertical surface or combination	•	•	•
Continuous horizontal & vertical	•	•	•
Other (incl rotary surface)	•	•	•
Contour Sawing and Filing	99	46	34
Cutoff Machines	1,173	494	452
Bandsaw (incl friction)	334	198	46
Abrasive disk	34	15	•
Hacksaws	524	228	224
Circular (incl friction)	205	49	125
Other	76	•	53
Drilling Machines	2,859	957	1,459
Sensitive	521	182	232
Upright: Single-spindle	1,550	505	771
Gang	27	•	15
Radial	635	232	372
Multi-spindle cluster, adjustable and fixed center	19	11	•
Automatic	•	•	•
Unit head & way type (not dial)	•	•	•
Deep-hole drills	•	•	•
Other (not incl special machines)	99	19	65
Gear Cutting and Finishing Machines	49	11	30
Hobbing machines, gear	•	•	•
Shapers, gear	19	•	19
Form-milling type (spur and bevel)	•	•	•
Bevel-gear cutters (not planer)	•	•	•
Grinders, gear tooth	•	•	•
Shavers, gear tooth	•	•	•
Burnishing and lapping	30	11	11
Chamfering, tooth pointing, tooth rounding	•	•	•
Other	•	•	•
Grinding Machines	4,742	1,437	2,298
External cylindrical: Plain	61	30	27
Universal	38	•	30
Internal cylindrical	57	19	30
Centerless: External	15	•	•
Internal	23	•	23
Surface: Rotary-table type	103	23	53
Reciprocating type	23	•	19
Disk, horizontal and vertical	34	•	11
Tool and cutter (incl drill)	851	262	414
Bench, floorstand, and snag	3,173	969	1,531
Jig grinders	34	11	•
Contour grinders	30	11	11
Abrasive belt (not polishing)	19	•	•
Other (except thread grinders)	281	84	137
Honing and Lapping	61	16	12
Honing: Internal (incl combination)	11	•	•
External and surface	15	•	•
Lapping: Surface	23	•	•
Cylindrical	•	•	•
Other (incl combination hone-lap)	•	•	•
Lathes	2,951	828	1,607
Bench, floor, lt-dy (incl turret attachment)	281	57	106
Engine, heavy-duty: Standard	1,569	410	999
Toolroom	361	99	217
Manufacturing and gap	57	15	34
Tracer	15	•	•
Turret lathes: Ram type	224	65	103
Saddle type	106	42	53
Auto chucking & between centers (single spindle)	27	11	•
Automatic chucking (multi-spindle)	30	11	•
Automatic screw machines (single spindle)	•	•	•
Automatic bar machines (multi-spindle)	•	•	•
Other (except spinning lathes)	281	118	91
Milling Machines	358	73	244
Bench type	11	•	•
Hand	•	•	•
Knee-type: Horizontal (plain & universal)	175	42	125
Vertical	65	•	57
Automatic & manufacturing	15	•	•
Ram type, swivel head	23	•	15
Bed (Lincoln) type, incl automatic rise and fall	•	•	•
Planer type (incl skin and spar)	30	•	19
Profilers, duplicators, diesinkers, engravers	•	•	•
Other (except thread milling)	27	15	•
Planers	266	61	179
Double housing	91	•	84
Openside and other	175	53	95
Pipe Cutting and Threading Machines	676	331	194
Polishing and Buffing Machines	148	68	49
Polishing stands (bench and floor)	114	46	49
Speed lathes	15	11	•
Abrasive-belt, disk, drum	19	11	•
Other	•	•	•
Shapers	623	171	418
Horizontal	471	141	308
Vertical, incl slotters & keyseaters	152	30	110
Threading (except pipe)	422	167	231
Tapping	46	46	•
Hobbing and milling	•	•	•
Die type	304	91	201
Grinders, thread	•	•	•
Rolling machines, thread	•	•	•
Other	72	30	30

	TOTAL	10-20 YEARS	OVER 20 YR
Electro-Erosion Machines (exc Tap disintegrators)	•	•	•
Ultrasonic Cutting Machines	•	•	•
Special Multi-Station Machines	•	•	•
In-line and transfer	•	•	•
Dial or rotary table	•	•	•
Automatic assembly (all types)	•	•	•
Other Metal-Cutting Machines	23	•	23
METAL-FORMING MACHINES	4,680	813	3,177
Bending and Forming Machines (Power)	707	185	427
Bending rolls, sheet and plate	270	49	190
Bending rolls, bars and shapes	11	•	•
Bending brakes	270	91	122
Rotary bending and forming machines	57	11	46
Bending machines, pipe, bar, and shapes	99	30	61
Wire and Strip Forming Machines	•	•	•
Hydraulic Presses	1,007	266	562
Vertical, single-action	547	194	258
Vertical, double and triple action	118	11	61
Horizontal	289	53	201
Extrusion (from hot billets)	•	•	•
Other (incl stretch and hydro-pneumatic)	53	•	42
Pneumatic Presses (except hydro-pneumatic)	141	•	114
Mechanical Presses (Power)	172	15	136
Inclinable, single-action (incl inclined)	15	•	15
Vertical, single-action: Straight-side (incl arch)	23	•	15
Vertical, single-action: Gap or C-frame	23	•	15
Vertical, single-action: Adjust. bed and horning	•	•	•
Double and triple action	•	•	•
Dieing machines	•	•	•
Horizontal (incl bulldozers)	84	11	72
Multiple transfer (incl eyeletting)	•	•	•
Other	15	•	11
Punching and Shearing Machines	1,440	210	1,068
Punching machines (incl turret)	574	76	433
Plate and sheet shears	407	80	274
Bar and angle shears	296	27	255
Rotary shears, incl slitters	61	19	34
Nibbling machines	49	•	30
Other	53	•	42
Forging Machinery (except presses)	943	99	794
Hammers, steam or air	547	53	475
Hammers, mechanical (incl drop and helve)	122	•	110
Forging machines (headers) and rolls	213	23	167
Swaging machines	46	•	38
Other	15	11	•
Riveting Machines (not portable)	259	30	65
Squeeze type	84	19	46
Rotary-vibrating type	•	•	•
Spinning type	•	•	•
Hammer type	175	11	19
Die Casting Machines	11	•	11
Hot chamber	11	•	11
Cold chamber	•	•	•
Plastics Molding Machines	•	•	•
Injection	•	•	•
Compression	•	•	•
Extrusion	•	•	•
WELDING EQUIPMENT	5,298	2,660	874
Electric Welding Equipment	5,149	2,588	840
Power source: Motor-generator set	3,838	2,177	699
Transformer and rectifier	498	84	23
Arc-weld machines (not hand) incl automatic	638	274	61
Resistance welders: Spot	84	30	23
Gun (not hand)	15	•	•
Seam	15	•	•
Butt and flash	61	15	34
Gas Welding Machines (not hand)	•	•	•
Flame Cutting Machines (not hand)	141	72	34
HEATING EQUIPMENT	1,322	331	729
Heat-treating furnaces	365	114	186
Atmosphere generators	•	•	•
Stock-heating furnaces	581	114	414
Salt baths	•	•	•
Induction heating units	68	•	•
Baking and drying ovens	239	84	72
Flame-hardening units	61	11	49
CLEANING AND FINISHING	445	87	27
Cleaning Equipment	430	83	23
Barrel finishing machines	•	•	•
Shot and abrasive blast	65	15	15
Parts washing machines (incl degreasers)	361	68	•
Pickling machines	•	•	•
Plating Equipment	15	•	•
Machines	•	•	•
Barrels	•	•	•
INDUSTRIAL TRUCKS (Power-Driven)	3,571	1,364	627
Lift (rider-type)	1,132	334	163
Truck-tractor	1,224	475	236
Powered hand trucks	372	171	87
Crane trucks	843	384	141
OTHER SHOP EQUIPMENT	1,596	377	624
Balancing Machines	65	27	•
Air Compressors	1,531	350	616
Gear-Checking Machines	•	•	•

Colleges and Vocational Institutes

This table summarizes the equipment holdings of 70 colleges and 17 vocational institutes, or a total of 87 training institutions. Figures represent an estimated 40% to 50% of the equipment used for training in such institutions.

	Reported Units	10 yrs & over	Over 20 yrs
METAL CUTTING	4,294	84%	17%
METAL FORMING	378	79	11
OTHER EQUIPMENT	1,213	78	9
TOTAL	5,885	82	15

• – Less than 10

	TOTAL	10-20 YEARS	OVER 20 YR
METAL-CUTTING MACHINES	4,294	2,838	746
Boring Machines	40	27	•
Horizontal boring, drilling, & milling	12	•	•
Vertical boring mills incl vert turret lathes	•	•	•
Precision, horizontal and vertical	•	•	•
Jig boring, horizontal and vertical	16	10	•
Other (except boring lathes)	•	•	•
Broaching Machines	14	13	•
Horizontal internal or combination	•	•	•
Horizontal surface	•	•	•
Vertical internal	•	•	•
Vertical surface or combination	•	•	•
Continuous horizontal & vertical	•	•	•
Other (incl rotary surface)	•	•	•
Contour Sawing and Filing	67	51	•
Cutoff Machines	254	172	27
Bandsaw (incl friction)	77	52	•
Abrasive disk	45	34	•
Hacksaws	119	79	17
Circular (incl friction)	13	•	•
Other	•	•	•
Drilling Machines	560	404	78
Sensitive	162	115	14
Upright: Single-spindle	284	213	37
Gang	42	36	•
Radial	53	28	17
Multi-spindle cluster, adjustable and fixed center	•	•	•
Automatic	•	•	•
Unit head & way type (not dial)	•	•	•
Deep-hole drills	•	•	•
Other (not incl special machines)	•	•	•
Gear Cutting and Finishing Machines	80	71	•
Hobbing machines, gear	21	16	•
Shapers, gear	34	31	•
Form-milling type (spur and bevel)	•	•	•
Bevel-gear cutters (not planer)	10	•	•
Grinders, gear tooth	•	•	•
Shavers, gear tooth	•	•	•
Burnishing and lapping	•	•	•
Chamfering, tooth pointing, tooth rounding	•	•	•
Other	•	•	•
Grinding Machines	843	646	99
External cylindrical: Plain	69	52	13
Universal	86	39	•
Internal cylindrical	22	19	•
Centerless: External	12	•	•
Internal	•	•	•
Surface: Rotary-table type	28	23	•
Reciprocating type	107	81	12
Disk, horizontal and vertical	•	•	•
Tool and cutter (incl drill)	133	92	20
Bench, floorstand, and snag	356	278	37
Jig grinders	•	•	•
Contour grinders	•	•	•
Abrasive belt (not polishing)	36	26	•
Other (except thread grinders)	13	10	•
Honing and Lapping	31	21	•
Honing: Internal (incl combination)	19	15	•
External and surface	•	•	•
Lapping: Surface	•	•	•
Cylindrical	•	•	•
Other (incl combination hone-lap)	•	•	•
Lathes	1,484	910	290
Bench, floor, lt-dy (incl turret attachment)	459	283	71
Engine, heavy-duty: Standard	546	265	176
Toolroom	315	241	20
Manufacturing and gap	16	14	•
Tracer	•	•	•
Turret lathes: Ram type	70	53	•
Saddle type	29	22	•
Auto chucking & between centers (single spindle)	•	•	•
Automatic chucking (multi-spindle)	•	•	•
Automatic screw machines (single spindle)	27	21	•
Automatic bar machines (multi-spindle)	•	•	•
Other (except spinning lathes)	•	•	•
Milling Machines	439	268	93
Bench type	31	23	•
Hand	18	11	•
Knee-type: Horizontal (plain & universal)	244	132	72
Vertical	79	51	•
Automatic & manufacturing	29	28	•
Ram type, swivel head	11	•	•
Bed (Lincoln) type, incl automatic rise and fall	•	•	•
Planer type (incl skin and spar)	•	•	•
Profilers, duplicators, diesinkers, engravers	16	10	•
Other (except thread milling)	•	•	•
Planers	47	•	39
Double housing	36	•	34
Openside and other	11	•	•
Pipe Cutting and Threading Machines	20	10	•
Polishing and Buffing Machines	128	81	27
Polishing stands (bench and floor)	35	26	•
Speed lathes	59	34	21
Abrasive-belt, disk, drum	34	21	•
Other	•	•	•
Shapers	245	132	74
Horizontal	226	122	67
Vertical, incl slotters & keyseaters	19	10	•
Threading (except pipe)	39	26	•
Tapping	•	•	•
Hobbing and milling	14	•	•
Die type	•	•	•
Grinders, thread	10	10	•
Rolling machines, thread	•	•	•
Other	•	•	•

	TOTAL	10-20 YEARS	OVER 20 YR
Electro-Erosion Machines (exc Tap disintegrators)	•	•	•
Ultrasonic Cutting Machines	•	•	•
Special Multi-Station Machines	•	•	•
In-line and transfer	•	•	•
Dial or rotary table	•	•	•
Automatic assembly (all types)	•	•	•
Other Metal-Cutting Machines	•	•	•
METAL-FORMING MACHINES	378	255	43
Bending and Forming Machines (Power)	135	92	•
Bending rolls, sheet and plate	31	22	•
Bending rolls, bars and shapes	•	•	•
Bending brakes	59	45	•
Rotary bending and forming machines	25	13	•
Bending machines, pipe, bar, and shapes	12	•	•
Wire and Strip Forming Machines	•	•	•
Hydraulic Presses	80	35	•
Vertical, single-action	45	32	•
Vertical, double and triple action	•	•	•
Horizontal	•	•	•
Extrusion (from hot billets)	•	•	•
Other (incl stretch and hydro-pneumatic)	•	•	•
Pneumatic Presses (except hydro-pneumatic)	•	•	•
Mechanical Presses (Power)	42	29	•
Inclinable, single-action (incl inclined)	29	22	•
Vertical, single-action: Straight-side (incl arch)	•	•	•
Vertical, single-action: Gap or C-frame	•	•	•
Vertical, single-action: Adjust. bed and turning	•	•	•
Double and triple action	•	•	•
Dieing machines	•	•	•
Horizontal (incl bulldozers)	•	•	•
Multiple transfer (incl eyeletting)	•	•	•
Other	•	•	•
Punching and Shearing Machines	107	79	13
Punching machines (incl turret)	12	•	•
Plate and sheet shears	40	28	•
Bar and angle shears	14	12	•
Rotary shears, incl slitters	•	•	•
Nibbling machines	28	23	•
Other	•	•	•
Forging Machinery (except presses)	12	•	•
Hammers, steam or air	•	•	•
Hammers, mechanical (incl drop and helve)	•	•	•
Forging machines (headers) and rolls	•	•	•
Swaging machines	•	•	•
Other	•	•	•
Riveting Machines (not portable)	16	10	•
Squeeze type	10	•	•
Rotary-vibrating type	•	•	•
Spinning type	•	•	•
Hammer type	•	•	•
Die Casting Machines	•	•	•
Hot chamber	•	•	•
Cold chamber	•	•	•
Plastics Molding Machines	•	•	•
Injection	•	•	•
Compression	•	•	•
Extrusion	•	•	•
WELDING EQUIPMENT	684	489	37
Electric Welding Equipment	626	447	34
Power source: Motor-generator set	303	248	17
Transformer and rectifier	191	111	•
Arc-weld machines (not hand) incl automatic	67	42	•
Resistance welders: Spot	53	35	•
Spot: Gun (not hand)	•	•	•
Seam	•	•	•
Butt and flash	•	•	•
Gas Welding Machines (not hand)	26	16	•
Flame Cutting Machines (not hand)	32	26	•
HEATING EQUIPMENT	304	179	52
Heat-treating furnaces	219	122	41
Atmosphere generators	•	•	•
Stock-heating furnaces	•	•	•
Salt baths	29	22	•
Induction heating units	20	14	•
Baking and drying ovens	21	12	•
Flame-hardening units	•	•	•
CLEANING AND FINISHING	32	15	•
Cleaning Equipment	31	14	•
Barrel finishing machines	•	•	•
Shot and abrasive blast	12	•	•
Parts washing machines (incl degreasers)	10	•	•
Pickling machines	•	•	•
Plating Equipment	•	•	•
Machines	•	•	•
Barrels	•	•	•
INDUSTRIAL TRUCKS (Power-Driven)	35	29	•
Lift (rider-type)	24	20	•
Truck-tractor	•	•	•
Powered hand trucks	•	•	•
Crane trucks	•	•	•
OTHER SHOP EQUIPMENT	198	121	11
Balancing Machines	12	•	•
Air Compressors	125	91	11
Gear-Checking Machines	21	21	•

High Schools

	Reported Units	10 yrs & over	Over 20 yrs
METAL CUTTING	18,618	76%	24%
METAL FORMING	968	66	21
OTHER EQUIPMENT	3,778	69	14
TOTAL	23,364	74	22

• – Less than 10

Figures in this table contain reports from 21 state Departments of Education on equipment used for high-school training purposes. These figures probably represent about one-third of total equipment in the nation's high schools.

	TOTAL	10-20 YEARS	OVER 20 YR
METAL-CUTTING MACHINES	18,618	9,640	4,485
Boring Machines	105	61	26
Horizontal boring, drilling, & milling	37	27	•
Vertical boring mills incl vert turret lathes	36	18	•
Precision, horizontal and vertical	•	•	•
Jig boring, horizontal and vertical	21	•	•
Other (except boring lathes)	•	•	•
Broaching Machines	•	•	•
Horizontal internal or combination	•	•	•
Horizontal surface	•	•	•
Vertical internal	•	•	•
Vertical surface or combination	•	•	•
Continuous horizontal & vertical	•	•	•
Other (incl rotary surface)	•	•	•
Contour Sawing and Filing	187	110	13
Cutoff Machines	1,258	612	217
Bandsaw (incl friction)	312	140	16
Abrasive disk	36	17	•
Hacksaws	856	435	195
Circular (incl friction)	46	17	•
Other	•	•	•
Drilling Machines	3,518	1,976	605
Sensitive	842	412	259
Upright: Single-spindle	2,450	1,428	298
Gang	67	46	•
Radial	126	70	36
Multi-spindle cluster, adjustable and fixed center	•	•	•
Automatic	•	•	•
Unit head & way type (not dial)	•	•	•
Deep-hole drills	•	•	•
Other (not incl special machines)	20	•	•
Gear Cutting and Finishing Machines	54	18	•
Hobbing machines, gear	•	•	•
Shapers, gear	21	•	•
Form-milling type (spur and bevel)	•	•	•
Bevel-gear cutters (not planer)	•	•	•
Grinders, gear tooth	•	•	•
Shavers, gear tooth	•	•	•
Burnishing and lapping	•	•	•
Chamfering, tooth pointing, tooth rounding	•	•	•
Other	•	•	•
Grinding Machines	3,497	2,899	605
External cylindrical: Plain	238	129	42
Universal	83	44	28
Internal cylindrical	38	19	14
Centerless: External	•	•	•
Internal	•	•	•
Surface: Rotary-table type	56	26	15
Reciprocating type	380	192	117
Disk, horizontal and vertical	13	•	•
Tool and cutter (incl drill)	389	231	84
Bench, floorstand, and snag	2,204	1,369	288
Jig grinders	•	•	•
Contour grinders	•	•	•
Abrasive belt (not polishing)	49	21	•
Other (except thread grinders)	26	10	•
Honing and Lapping	•	•	•
Honing: Internal (incl combination)	•	•	•
External and surface	•	•	•
Lapping: Surface	•	•	•
Cylindrical	•	•	•
Other (incl combination hone-lap)	•	•	•
Lathes	6,844	3,290	2,006
Bench, floor, ft-dy (incl turret attachment)	3,160	1,622	732
Engine, heavy-duty: Standard	2,406	982	993
Toolroom	1,096	575	224
Manufacturing and gap	20	10	10
Tracer	•	•	•
Turret lathes: Ram type	55	29	22
Saddle type	32	29	•
Auto chucking & between centers (single spindle)	•	•	•
Automatic chucking (multi-spindle)	•	•	•
Automatic screw machines (single spindle)	15	10	•
Automatic bar machines (multi-spindle)	•	•	•
Other (except spinning lathes)	58	33	17
Milling Machines	1,447	745	451
Bench type	233	115	31
Hand	102	56	36
Knee-type: Horizontal (plain & universal)	710	372	247
Vertical	328	160	98
Automatic & manufacturing	12	•	•
Ram type, swivel head	16	10	•
Bed (Lincoln) type, incl automatic rise and fall	27	•	25
Planer type (incl skin and spar)	12	•	•
Profilers, duplicators, diesinkers, engravers	20	13	•
Other (except thread milling)	•	•	•
Planers	148	43	84
Double housing	102	32	68
Openside and other	46	11	16
Pipe Cutting and Threading Machines	39	24	•
Polishing and Buffing Machines	364	174	46
Polishing stands (bench and floor)	250	112	38
Speed lathes	60	52	•
Abrasive-belt, disk, drum	51	•	•
Other	•	•	•
Shapers	1,096	496	403
Horizontal	1,081	487	400
Vertical, incl slotters & keyseaters	15	•	•
Threading (except pipe)	38	23	•
Tapping	16	13	•
Hobbing and milling	•	•	•
Die type	11	•	•
Grinders, thread	•	•	•
Rolling machines, thread	•	•	•
Other	•	•	•

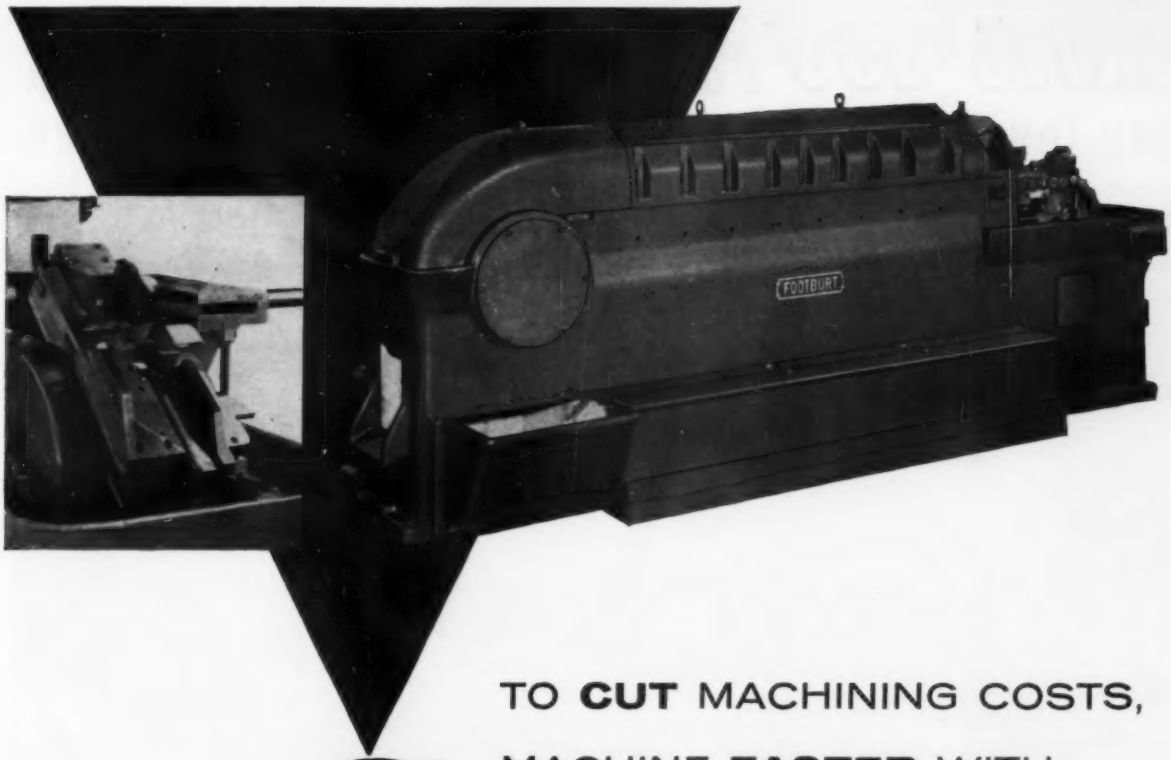
	TOTAL	10-20 YEARS	OVER 20 YR
Electro-Erosion Machines (exc Tap disintegrators)	•	•	•
Ultrasonic Cutting Machines	•	•	•
Special Multi-Station Machines	•	•	•
In-line and transfer	•	•	•
Dial or rotary table	•	•	•
Automatic assembly (all types)	•	•	•
Other Metal-Cutting Machines	19	•	10
METAL-FORMING MACHINES	968	435	206
Bending and Forming Machines (Power)	448	197	77
Bending rolls, sheet and plate	136	59	26
Bending rolls, bars and shapes	23	•	•
Bending brakes	180	85	28
Rotary bending and forming machines	77	27	14
Bending machines, pipe, bar, and shapes	49	18	•
Wire and Strip Forming Machines	•	•	•
Hydraulic Presses	74	43	16
Vertical, single-action	60	39	15
Vertical, double and triple action	•	•	•
Horizontal	•	•	•
Extrusion (from hot billets)	•	•	•
Other (incl stretch and hydro-pneumatic)	•	•	•
Pneumatic Presses (except hydro-pneumatic)	•	•	•
Mechanical Presses (Power)	56	28	19
Inclinable, single-action (incl inclined)	20	11	•
Vertical, single-action: Straight-side (incl arch)	•	•	•
Vertical, single-action: Gap or C-frame	22	•	11
Vertical, single-action: Adjust. bed and horning	•	•	•
Double and triple action	•	•	•
Dieing machines	•	•	•
Horizontal (incl bulldozers)	•	•	•
Multiple transfer (incl eyeletting)	•	•	•
Other	•	•	•
Punching and Shearing Machines	342	156	80
Punching machines (incl turret)	28	21	•
Plate and sheet shears	171	63	53
Bar and angle shears	53	24	16
Rotary shears, incl slitters	26	13	•
Nibbling machines	55	32	•
Other	•	•	•
Forging Machinery (except presses)	17	•	•
Hammers, steam or air	•	•	•
Hammers, mechanical (incl drop and helve)	•	•	•
Forging machines (headers) and rolls	•	•	•
Swaging machines	•	•	•
Other	•	•	•
Riveting Machines (not portable)	11	•	•
Squeeze type	•	•	•
Rotary-vibrating type	•	•	•
Spinning type	•	•	•
Hammer type	•	•	•
Die Casting Machines	•	•	•
Hot chamber	•	•	•
Cold chamber	•	•	•
Plastics Molding Machines	•	•	•
Injection	•	•	•
Compression	•	•	•
Extrusion	•	•	•
WELDING EQUIPMENT	2,655	1,519	267
Electric Welding Equipment	2,505	1,481	261
Power source: Motor-generator set	1,285	1,024	141
Transformer and rectifier	1,006	326	79
Arc-weld machines (not hand) incl automatic	116	47	17
Resistance welders: Spot	125	65	14
Gun (not hand)	29	18	10
Seam	•	•	•
Butt and flash	•	•	•
Gas Welding Machines (not hand)	57	22	•
Flame Cutting Machines (not hand)	33	16	•
HEATING EQUIPMENT	550	214	157
Heat-treating furnaces	464	175	120
Atmosphere generators	•	•	•
Stock-heating furnaces	26	•	•
Salt baths	10	•	•
Induction heating units	•	•	•
Baking and drying ovens	46	•	27
Flame-hardening units	•	•	•
CLEANING AND FINISHING	42	10	21
Cleaning Equipment	42	10	21
Barrel finishing machines	•	•	•
Shot and abrasive blast	•	•	•
Parts washing machines (incl degreasers)	37	•	21
Pickling machines	•	•	•
Plating Equipment	•	•	•
Machines	•	•	•
Barrels	•	•	•
INDUSTRIAL TRUCKS (Power-Driven)	26	21	•
Lift (rider-type)	11	•	•
Truck-tractor	•	•	•
Powered hand trucks	•	•	•
Crane trucks	•	•	•
OTHER SHOP EQUIPMENT	505	312	81
Balancing Machines	•	•	•
Air Compressors	497	305	81
Gear-Checking Machines	•	•	•

American Machinist EIGHTH INVENTORY OF METALWORKING EQUIPMENT

INDEX

A single alphabetical list including industries by name, areas by state, and equipment by type

Air Compressors 88
Air Transport 92
Aircraft 32
Aircraft Engines, Propellers, and Parts 33
Alabama 45
Arc Welding 84
Arkansas 54
Arizona 60
Balancing Machines 88
Bending Machines 77
Boring Machines 61
Broaching Machines 62
Buffing Machines 74
California 59, 60
Cleaning Equipment 87
College Shops 94
Colorado 57
Communications Equipment 30
Connecticut 38
Construction Equipment 22
Contour Sawing 63
Cutoff Machines 63
Delaware 41
Die-Casting Machines 83
District of Columbia 43
Drilling Machines 64
Electrical Equipment 28
Electro-Erosion Machines 76
Equipment Analysis 11
Fabricated Metal Products 26
Farm Machinery 21
Flame Cutting Machines 85
Florida 45
Forge Shops 36
Forging Machinery 80
Forming Machines 77
Foundry Machine Shops 36
Gas Welding Machines 85
Gear Checking Machines 88
Gear Cutting and Finishing Machines 65
General Industrial Equipment 25
General Maintenance 91
Geographic Analysis 16
Georgia 45
Government-Owned Tools 10
Grand Summary 2
Grinding Machines 66, 67
High Schools 95
Honing Machines 72
Household Appliances 29
Hydraulic Presses 78
Idaho 57
Illinois 51, 54
Indiana 50, 51
Industrial Trucks 88
Industry Analysis 6
Iowa 51
Job Shops 16
Kansas 55
Kentucky 48, 54
Lapping Machines 72
Lathes 68, 69
Louisiana 45
Maine 37
Maryland 42, 43
Massachusetts 37
Materials Handling Equipment 22
Materials Heating Equipment 86
Mechanical Presses 79
Metalworking Machinery 23
Milling Machines 70, 71
Mining Equipment 22
Michigan 49, 51, 53
Minnesota 53
Miscellaneous Machine Parts 36
Mississippi 45
Missouri 54, 55
Montana 57
Motor Vehicles and Parts 31
Nebraska 57
Nevada 59, 60
New Hampshire 37
New Jersey 39
New Mexico 56
New York 39
North Carolina 44
North Dakota 57
Office Machines 27
Ohio 42, 46, 47, 48
Oil-Well Equipment 22
Oklahoma 55
Ordnance 35
Oregon 58
Other Machine Tools 76
Pennsylvania 41, 42
Pipe Cutting and Threading Machines 74
Planers 73
Plastics-Molding Machines 83
Plating Equipment 87
Pneumatic Presses 78
Polishing Machines 74
Precision Mechanisms 34
Punching Machines 82
Railroad Equipment 35
Railroad Maintenance 93
Resistance-Welding Machines 84, 85
Rhode Island 37
Riveting Machines 81
Service Equipment 27
Shapers 73
Shearing Machines 82
Shipbuilding 35
South Carolina 44
South Dakota 57
Special-Industry Machinery 24
Special Multi-Station Machines 76
Store Machines 27
Swaging Machines 80
Tennessee 45, 54
Texas 56
Threading 75
Ultrasonic Cutting Machines 76
Utah 57
Vermont 37
Virginia 44
Vocational Institutes 94
Washington 58
Welding 84, 85
West Virginia 42
Wire, Strip Forming Machines 77
Wisconsin 52, 53
Wyoming 57



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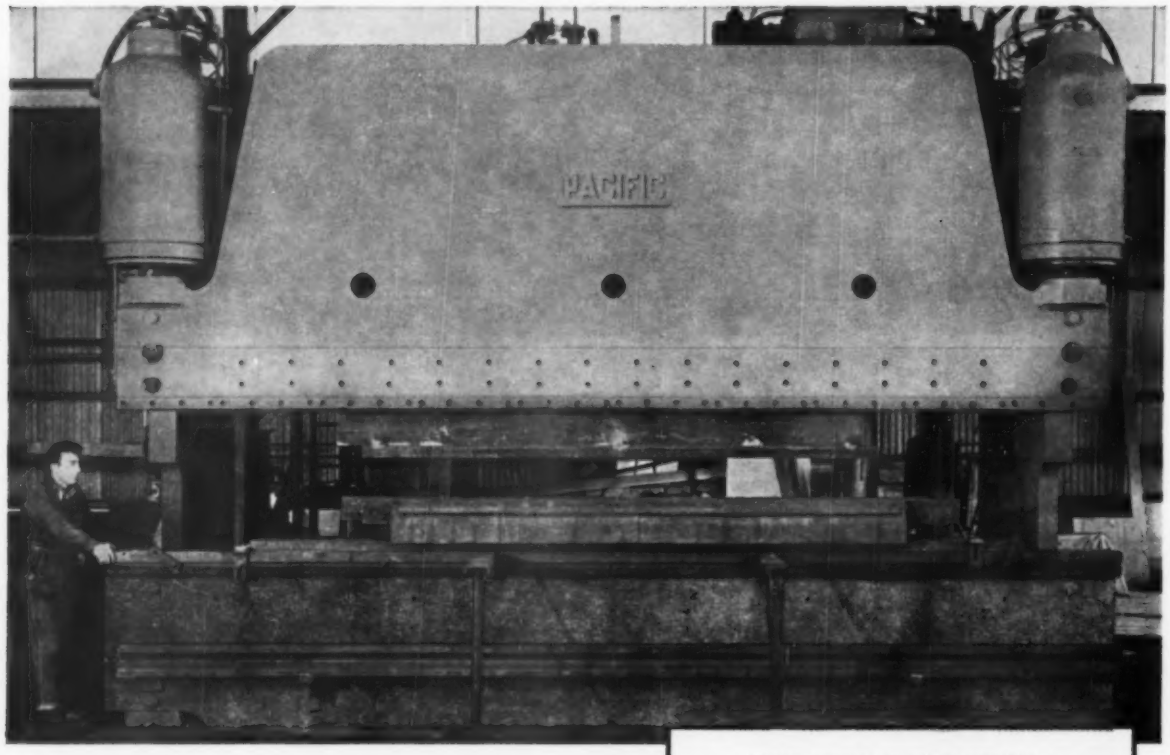

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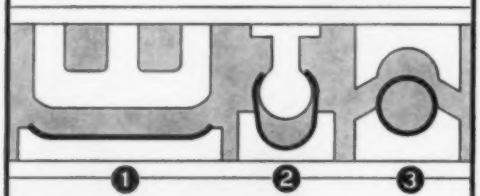

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Slug-Disposal Methods—I

By Allan Young, Tool Engineering Department, Collins Radio Co, Cedar Rapids, Iowa

Too often little is done to provide correct slug disposal at the design stage of many dies. Here are 15 pointers to consider when designing a cutting die, because one jammed or stuck slug is all that is needed to break a die or damage a press

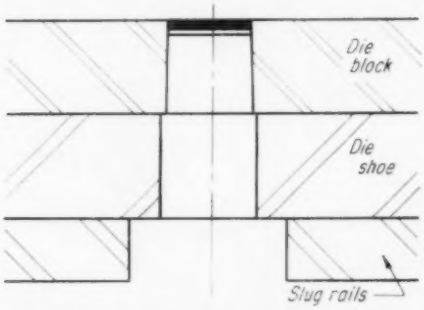

Fig. 1—Slug rails are bolted to the shoe of the push-through pierce or blank die

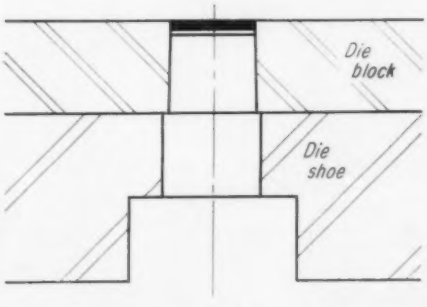

Fig. 2—Channel milled in die shoe disposes of slugs for a push-through die

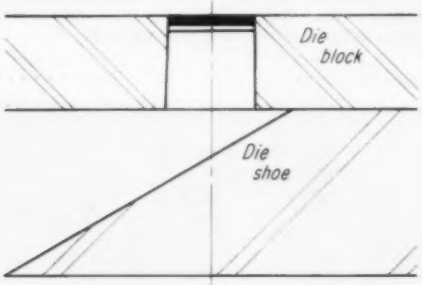

Fig. 3—Angular channel machined in die shoe directs slugs in specified direction

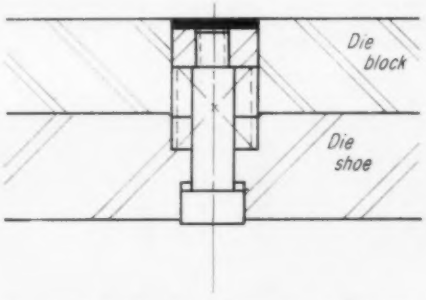

Fig. 4—Spring-loaded pressure pad pushes slug back into strip stock

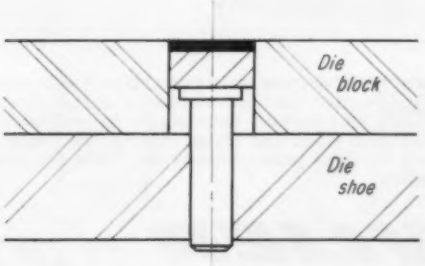

Fig. 5—Air pressure, instead of a spring, is used to push back the slug

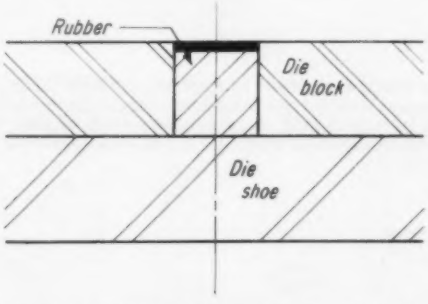

Fig. 6—A rubber pad inserted in the die block is another means of returning the slug

Practical Tooling Tips

No. 3 of a series

Are your tool makers wasting time making complicated tooling gadgets when a standard, off-the-shelf Vlier part could do the job much better? Why not examine your present drawings and see where these simple, low-cost parts can be used. You will be amazed at the savings possible.

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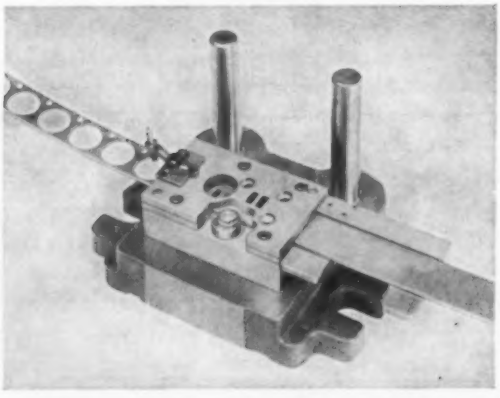
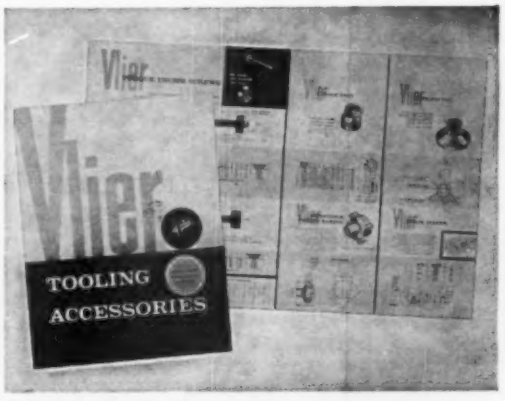


PROPER STOCK ALIGNMENT IN PROGRESSIVE DIES becomes a simple task with the new Vlier Stock Pusher. Saves pilots. Mounts in tapped hole. Accommodates stock as thin as .010"; width variations totalling 1/16". Nothing to wear out or foul up.



NEW 1958 CATALOG NOW AVAILABLE—Eight pages; completely revised. Includes information and specifications on all new Vlier products, including the Torque Handle, Stock Pusher, Leveling Pad. Makes ordering easy. Suggests new uses for these proven time-savers. Write for your copy today!

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Slug-Disposal Methods—II

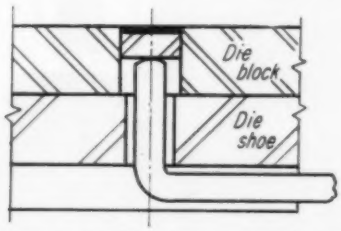

Fig. 7—Ejection lever operated by hand or foot lifts blank or slug, need not push it back into strip

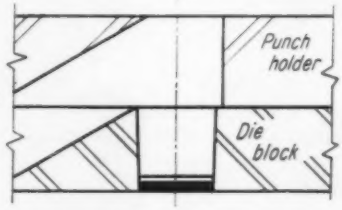

Fig. 8—Natural vibration causes slug to slide out of angular slot in inverted die

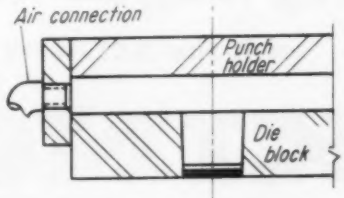

Fig. 9—Air blast removes slug from inverted piercing die

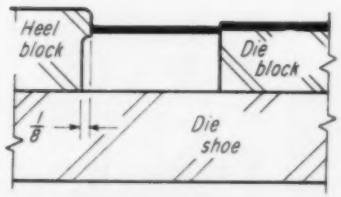

Fig. 10—In cut-off die, the part is pushed or blown off the shoe. Relief on heel prevents wedging

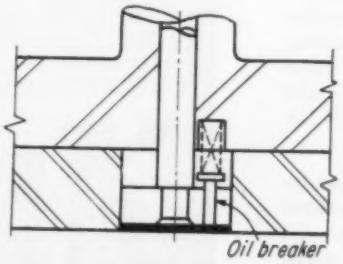

Fig. 11—Oil breaker in ordinary compound die prevents part from sticking and double blanking

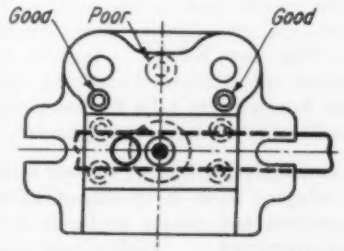

Fig. 12—Don't mount stop block between guide posts to keep parts from being blown out the back

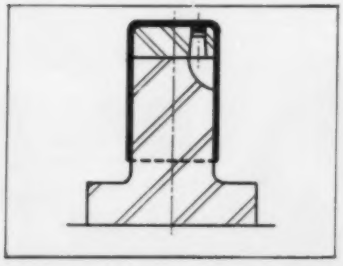

Fig. 13—Relief notches in diagonal corners of horn free slugs punched into die-block cap

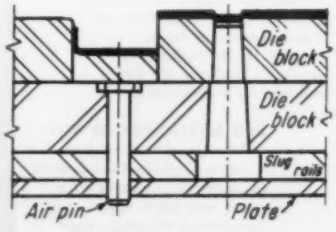

Fig. 14—Auxiliary slug plate under the slug rails keeps slugs from dropping onto an air cushion

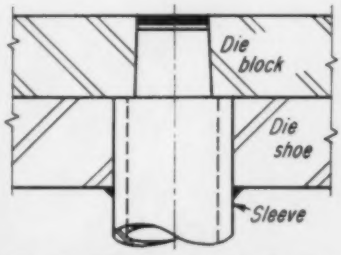

Fig. 15—Sleeve welded to die shoe assures that slugs will actually drop through the bolster

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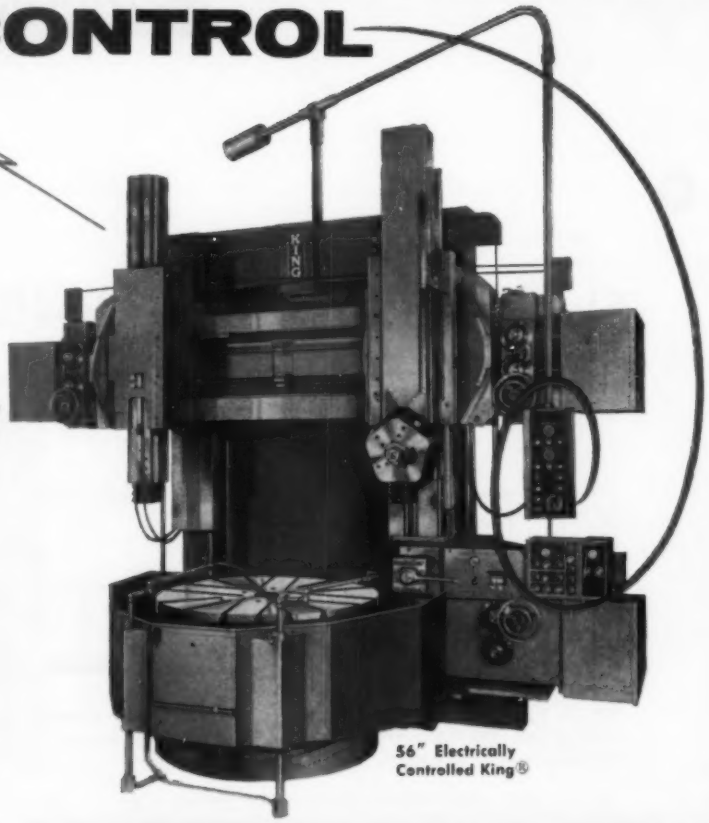

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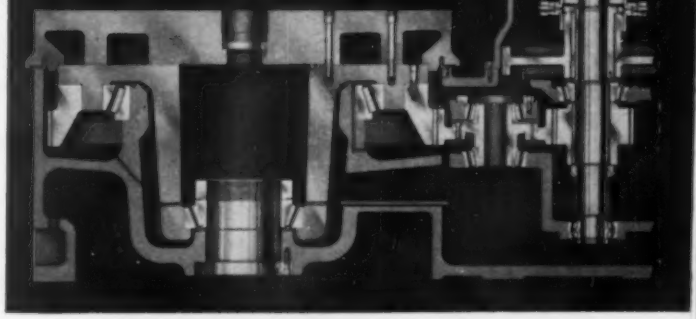

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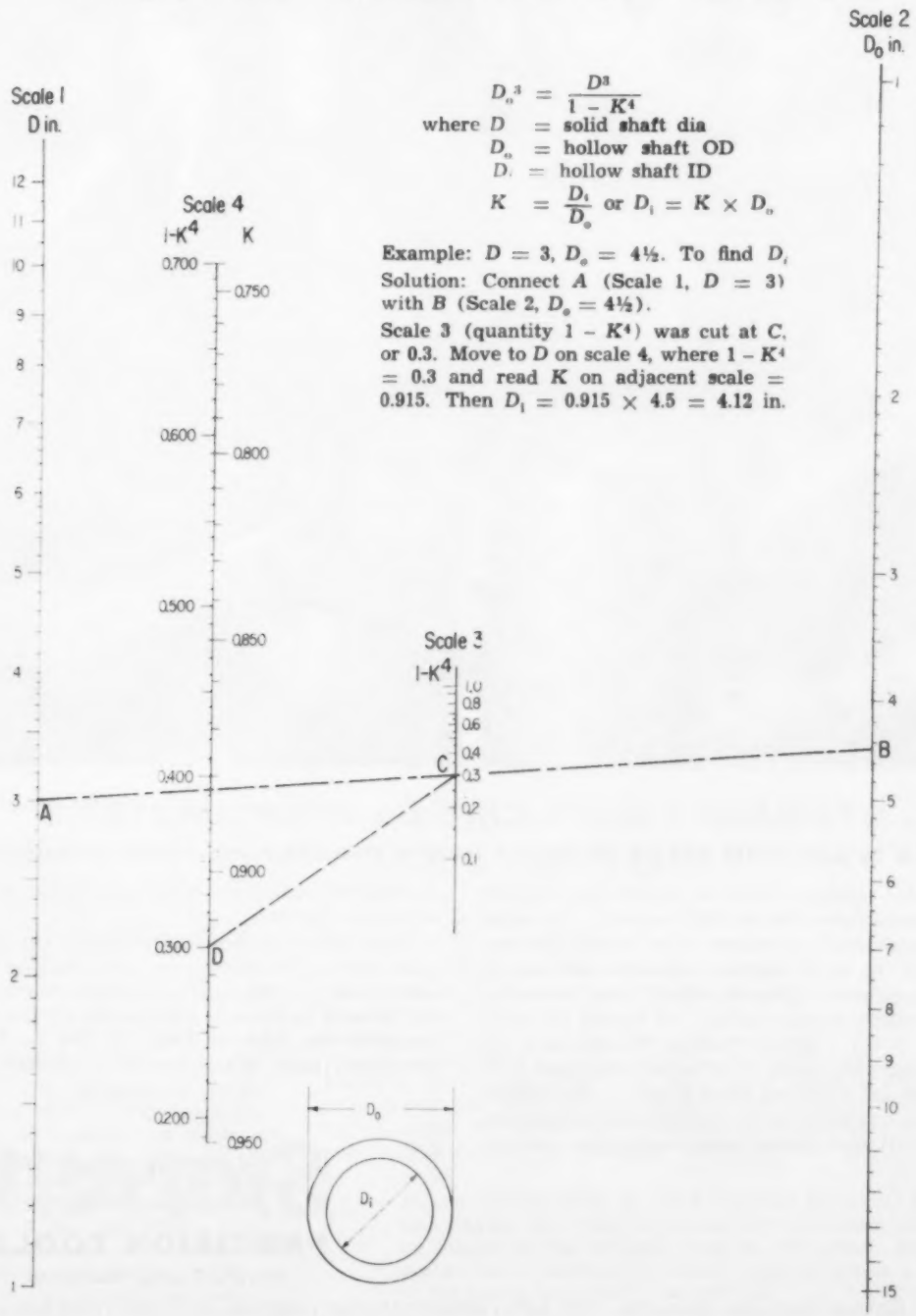
Torsional Strength of Shafts

By Michael M Lachowski, registered professional engineer, Coraopolis, Pa

Nomograph for solid and hollow shafts of equal torsional strength



$$D_o^3 = \frac{D^3}{1 - K^4}$$

where D = solid shaft dia
D_o = hollow shaft OD
D_i = hollow shaft ID
$K = \frac{D_i}{D_o}$ or $D_i = K \times D_o$

Example: $D = 3$, $D_o = 4\frac{1}{2}$. To find D_i
Solution: Connect A (Scale 1, $D = 3$) with B (Scale 2, $D_o = 4\frac{1}{2}$).
Scale 3 (quantity $1 - K^4$) was cut at C, or 0.3. Move to D on scale 4, where $1 - K^4 = 0.3$ and read K on adjacent scale = 0.915. Then $D_i = 0.915 \times 4.5 = 4.12$ in.

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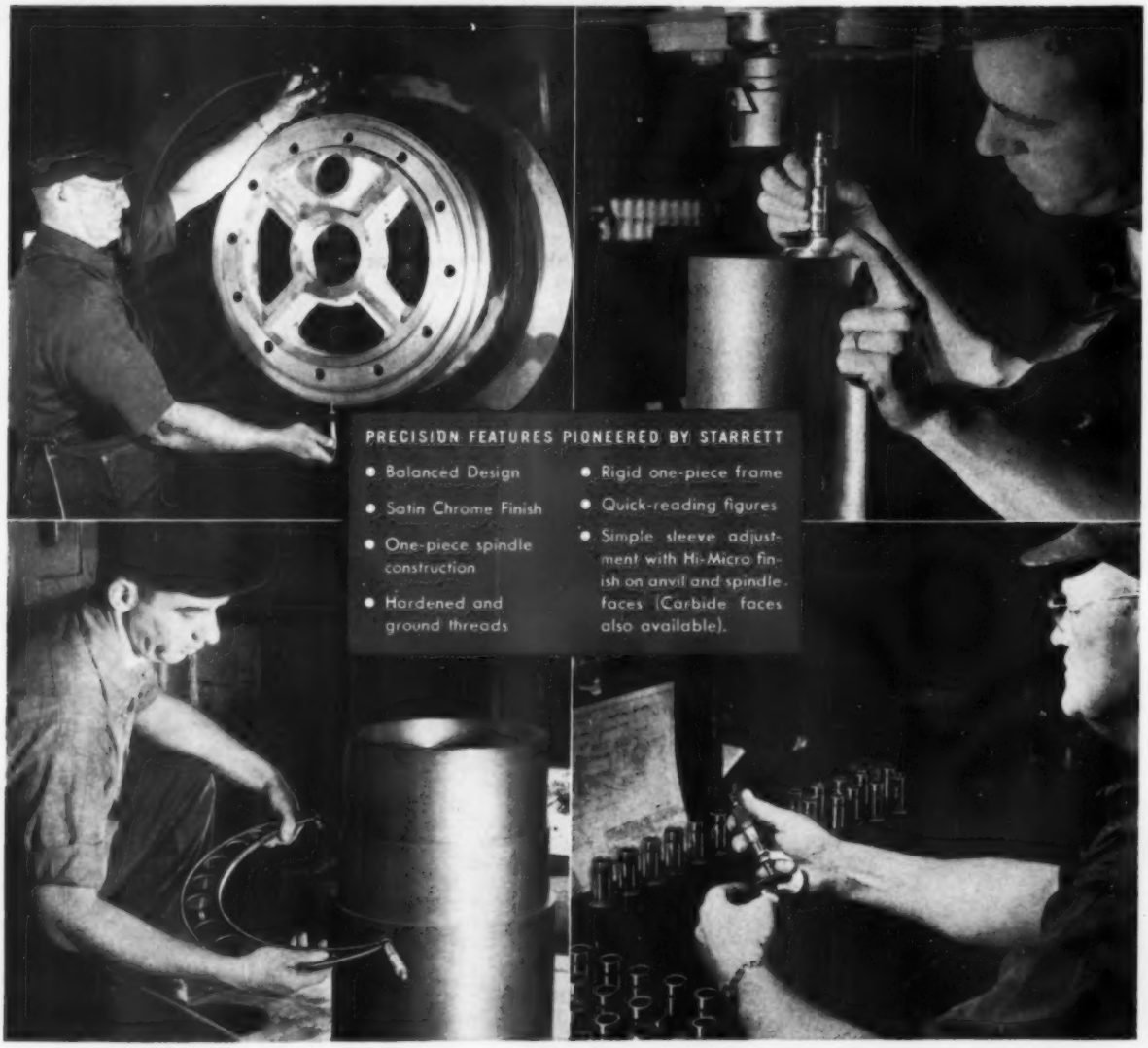
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Talking Shop...

Heat-Treating

A SUCCESSFUL PRIVATE detective has nothing on a competent heat-treater when it comes to solving mysteries. Indeed some of the traits of the private eye are needed to track down the felon that causes rejection after a heat-treating. An interesting collection of "Heat-Treating Hints" is published periodically by Lindberg Engineering Co. The current collection includes a tale, probably not mythical, of a series of ½-in. nuts that wouldn't plate properly. The nuts were carbonitrided, then vapor degreased. Other sizes worked all right but not the ½-in. Turned out a different lubricant was used on this size that left a heavy sludge in the base of the threads—so heavy the mild acid of the vapor degreaser didn't clean it all out. Answer was the clean the parts in a hot caustic solution, then a mild acid bath.

Saucer Factory?

JET NOISE is being investigated from many angles. One of the most interesting is to use many small engines, perhaps 40, along the wing. These engines would be ducted together out a long narrow slot in the rear of the wing. Producing a nightmare like that would at least get your plant in shape to build flying saucers.

That Clouded Crystal

BACK IN 1939, the sensation of the New York World's Fair was the Futurama with its forecast of life in America in 1960. The intriguing little publication *Miniaturesque* is tactless enough to review that forecast in detail. Beautiful 14-lane highways with separate lanes for 50, 75, and 100 miles per hour led to a city with precisely divided residential, commercial, and industrial districts (but no suburbs). All the parking was underground. All the sidewalks were elevated. By 1960, it was forecast, there would be 38 million cars. Well, we have already passed 54 million! Part of the dream came true. As for the rest, the planners must have been too busy looking for a place to park to carry it out.

Gun Boosted

THE GUN MAY BE getting rather old fashioned (except for westerns) in this missile age, but explosives are hanging on, and not only for explosive forming and metal-cutting research. Armour Research Foundation has been working on gun-boosted rockets. Development has included designs of varied caliber and application (air-to-air, ground-to-air, air-to-ground, and ground-to-ground). Two programs sponsored by Army Ordnance are reported to have reached the limited production stage.

Foil Welding

WHEN YOU HEAR about "foil welding" don't be misled into thinking it involves the welding of foil. It's a resistance seam-welding process in which a thin foil of steel is placed over the butted edges to be welded. The foil distributes current to both sheets to be welded and produces a smooth non-overlapping seam. It is also known as the "Peco" process and was developed in Germany. The American licensee is Precision Welder and Flexopress Co.

MEMOS

by BESS RITTER

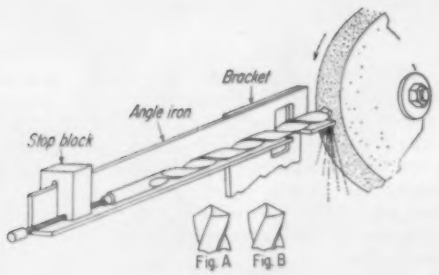
Iron is a magical metal in some European countries, which can cause either bad or good luck: In England, for example, superstitious folk believe that it's bad luck to bring old metal into the house—and this even includes a rusty bent nail picked up by the roadway.

In Scotland a piece of iron can save a child from being transformed by fairy folk into a "changling," and the procedure simply consists of placing a piece of the metal on the window-sill or on the door's threshold.

A mystery took place in England in January, 1946, and seems to clinch an old superstition that when a stopped clock does strike, it predicts a death in the family. This particular clock, which was one of those big self-standing numbers, had been owned by the family for more than 20 years. It had never kept the time in this house, as it had been purchased and used as an ornament for the hallway. Yet for no known reason it started to strike, and didn't stop until it had pealed a full sixty chimes. The clock was immediately carefully examined, but no reason for its eccentric behavior could be found. A week later a member of this family died.

Twelve months later, the clock repeated its earlier performance. Again the works were carefully examined, and again no reason for the chiming could be discovered. And again death struck—this time in distant Australia, where a member of the family happened to be residing.

Practical Ideas...



Economy Drill-Grinding Jig

We, like men in other small shops, sharpen our drills by hand-holding them against the grinding wheel and gaging our cutting edges by sight. Chances of getting well balanced cutting edges with this method are very small, even if done by an experienced operator.

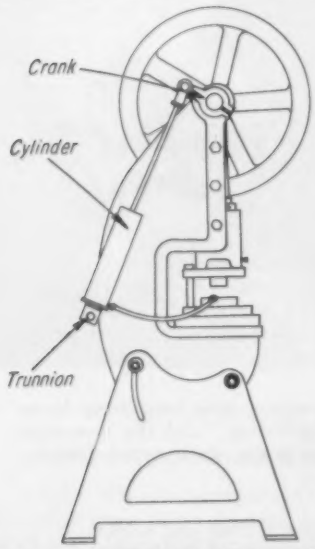
To insure more accurately ground drills, and instead of spending a lot of money for a good commercial grinding fixture, we made up the simple fixture shown. It consists of a length of 1½ x ¾ x ⅛-in. angle iron mounted on a bracket. The lower end of the bracket is equipped with a clamping arrangement to suit the individual tool rest.

When mounting the fixture, the angle iron is set at 59° to the axis of the grinder shaft and horizontally with the center of the wheel. This produces a conical point with the customary 118° included angle.

A slot cut through the angle iron and bracket permits access to the drill so it can be rotated. An adjustable-stop block with an adjustment and feed screw mounts on the vertical leg of the angle iron and is locked with a thumbscrew on the back of the block.

Here is how the fixture is used: The drill is dropped into place, as shown in the sketch, when the wheel is at rest. Stop block is then located to allow the drill to touch the wheel. After starting the wheel the drill is rotated and the feed is increased until both lips are cleaned up. A badly out-of-shape drill point will, after grinding, look something like Fig. A. The drill is then removed and the lips are backed off free hand to the shape shown in Fig. B.

William Martin, Brooklyn, NY



Press Generates Its Own Air

Here is how a small stamping shop can have a supply of compressed air for ejecting parts without the expense of operating a separate compressor. The arrangement shown not only provides free air, but the blast can be timed to supply it at any interval of the press cycle. If a short concentrated blast is desired, a spring-loaded valve is used to build up the pressure in the cylinder before the air is released.

The cylinder can either be manufactured from tubing (bicycle pump fashion) or one may be purchased from a surplus outlet. The lower end of the cylinder pivots on a trunnion fastened to the press frame. A crank arm, clamped to the protruding end of the press crank shaft, connects with the plunger rod through a crank pin.

This clamping arrangement of the crank arm is what permits air to be delivered at any position of the press stroke. A length of rubber hose, from the bottom end of the cylinder to the die, completes the hookup.

H Koslow, Bronx, NY

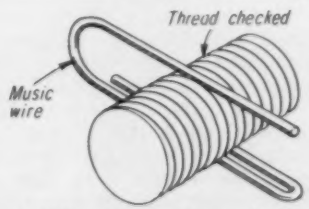
Screw Cleans Tapped Hole

Hard particles and scale sometimes make it necessary to clean a tapped hole after heat-treating a piece of steel. To do this with an old tap is inviting trouble because of the great probability of breaking the tap in the hole.

A safe tool to use for this job is to grind two or three flutes on a hollow-head capscrew. The inherent toughness of these screws is generally sufficient to do a good job of cleaning scale out of threads.

The cutting edges are produced by holding the screw against the sharp corner of a pedestal-grinder wheel. These edges will stand up well enough to clean quite a few holes, and the precaution will pay off in time saved in removing a broken tap.

William De Groat, Altadena, Calif



Bent Wire Eases Thread Check

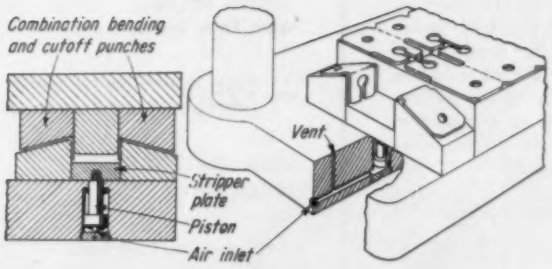
The three-wire system has long been accepted as the best way for checking threads. However, three loose wires are difficult to hold in place while measuring a thread being chased in the lathe.

An easy way to do this is to form a three-wire gage of music wire using a size selected from tables found in tool-manufacturers' catalogs. The best size, and others, are given for each pitch.

While music wire will not be accurate enough for fine inspection work, it will be good enough for matching a thread when a nut is not available or impractical to try. It is preferable to establish a measurement with a known good thread, but if the best wire size can be closely matched, good results can be obtained by calculating the measurement across the wires.

The gage shown may be conveniently formed with a pair of long-nose pliers. The wire should be spaced to suit the diameter and pitch of the thread to be measured.

Lewis H Zirkle, Baltimore, Md



Air Powers Stripper Plate

Recently, during the construction of a high production die, the problem of part removal stood out as a major obstacle. Mechanical methods would have been costly to incorporate, and springs were ruled out as we wanted the stripper out of the way while the parts were formed. Air blasts, we felt, would not be reliable enough to loosen the parts from the form blocks, so this idea was abandoned.

Instead we utilized a short air blast to power a stripper plate. The stripper bolt, which was screwed into the plate, served as piston, while the counterbore in the die shoe acted as cylinder. A plug sealed off the bottom, and a hole, drilled from the end of the shoe, connected the air line to the cylinder. Air bleed-off was through a small vent into the air hole. The stripper plate, as well as the stripper bolt, must fit fairly loose else they hang up and damage the parts during the bending process.

This is the way it works: After the die has performed its primary operations, two parts are simultaneously cut off at the edge of the die block. The combination cutoff and forming punches descends further to form the two parts.

An air valve, activated by a cam on the crank shaft, allows a blast of air to raise the stripper plate to its full height before the crank shaft reaches top center, at which point the valve shuts off. This rapid thrust of the stripper throws the parts clear of the die from where they are carried away by chutes. The stripper then returns to its lower position as the air is bled off through the vent hole.

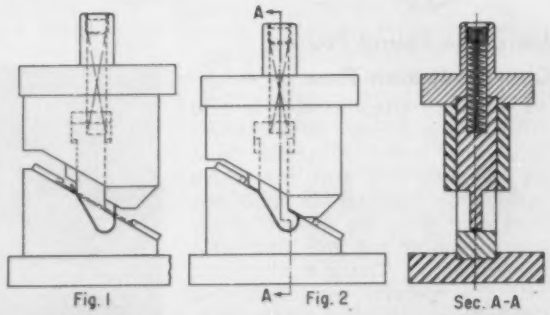
Edwin H Stock, St Louis, Missouri

Die Forms Cup Handle With Single Stroke of the Press

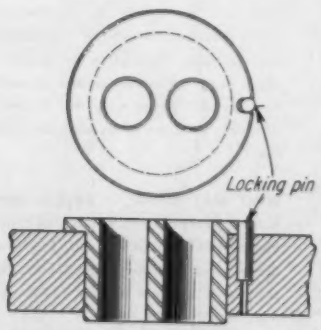
In tooling up for an inexpensive line of kitchen ware, corners had to be cut where production costs were concerned. I therefore designed and built the simple die shown which forms the handle for an aluminum measuring cup in one simple operation. Some of the blanks used are pierced for riveting, others are not pierced and are spot welded to the cups; this die accepts both kinds with equal ease.

The blanks are nested between two stop blocks while die is in open position. (Unbent blank is indicated by dashed line in Fig. 1). In the same view, the spring-loaded punch performs the forming operations before the solid punch bends the two pads.

Fig. 2 shows the solid punch completing the part. When the press stroke reaches top center, the handle is stripped sideways off the punch. This is made easier by the slight springback of the material in the handle.



Alex W Knudsen, Rocky River, Ohio



Duplex Drill Bushing Solves Jig Problem

While constructing a drill jig recently, we had to locate a pair of holes that were so closely situated that separate drill bushings could not be used.

The problem was neatly solved with a duplex drill bushing containing both holes. This bushing was accurately made by laying out, drilling, and reaming the two holes through a piece of oversize round stock. The piece was then chucked in the lathe and the holes indicated to equalize the wall thickness outside the far sides of the holes. The outside diameters and flange were turned as shown, after which a small slot was milled in the flange for a stop pin.

The location for the duplex bushing was next found by laying out the center of the distance of the two hole locations on the jig. After boring the jig plate to receive the bushing in a pressed fit, the bushing was installed and the holes checked for position. When properly located, the bushing was locked with a stop pin.

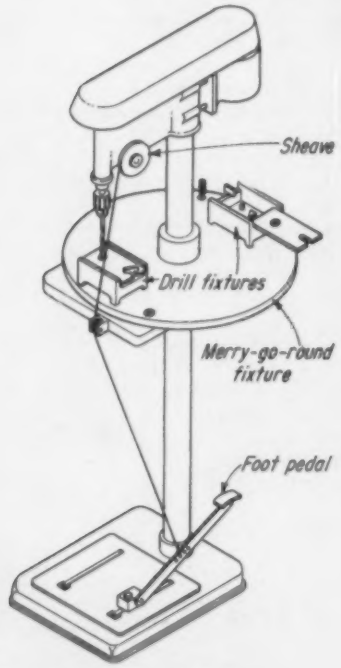
Federico Strasser, Santiago, Chile

First Aid Hint

If you get a bothersome sliver in your finger, too small to see with the naked eye, try stroking it with a piece of fine abrasive cloth. When done right, the sliver will come out without your even knowing it.

Richard John Bauer, E Cleveland, Ohio

Practical Ideas...



Merry-Go-Round Fixture Cuts Production Time

An auxiliary circular table is here fitted to the column of a conventional floor model drillpress. On it are mounted two drill jigs which enable the operator to drill one workpiece while he unloads a jig, deburrs the drilled hole, and again reloads the jig. This is accomplished with the operator working behind the drillpress where he applies drill-feed pressure with a foot pedal during his manipulation of workpieces.

The circular table, made of steel plate, is equipped with a bronze bushing having a snug fit on the drillpress column. Two bronze rails which support the round plate are screwed to the regular table as is a bar carrying a drill bushing for indexing. Rails and the bar, being under the circular table, are not visible in the sketch.

Two drill bushings are located diametrically across from each other near the edge of the fixture table. A locating pin inserted into either of these bushings will engage the bushing in the bar under the table for positive indexing. With the table thus locked, drill fixtures are positioned and secured.

The feed-handle unit is removed from the feed-pinion shaft and replaced with a large-diameter sheave. From this sheave to the foot pedal runs a ⅛-in. flexible steel cable which is guided over the edge of the drillpress table by a small pulley. The foot pedal pivots on a trunnion block bolted to the drillpress base.

Ernest Jones, Bronx, N Y

Springs Simplify Chuck Mounting

When an overhead hoist has to be used in mounting a chuck on a spindle, the operator will sometimes have difficulty in controlling the vertical movement of the hoist. This is true whether the spindle is threaded or employs the newer stud-and-cam lock device.

To simplify this job we are now using the arrangement shown in the photo. Four heavy tension springs are coupled between two round pads, one with an eyebolt for the hoist hook, and the other linked to the chuck eyebolt.

With the chuck thus suspended, the operator locates the center of

the chuck slightly above the lathe center. He then, rather than jockey the hoist up and down, simply pulls the chuck down by hand until alignment is made.

One large spring could possibly have served the purpose as well; we just happened to have these springs available and found it took four to carry the load. However, using four springs may be safer, because if one should snap the rest would temporarily support the chuck.

H J Gerber, assistant prof, head of machine shop dept, Oklahoma State University, Stillwater, Okla

JOSEPH POLINAK
West Palm Beach, Fla

won $25 in addition to regular payment for his idea:

SPIRAL-FLUTE TAP DRILLS TOO

in the Aug 25, 1958 issue

An extra $25 will be paid for the best Practical Idea in each issue of *American Machinist*. Selection of the winner is made by a group of our readers.

PAYMENT—$25 in addition to regular rates for the items published to be paid as soon as reader votes are received—usually three to four weeks after the date of issue. The winner will also be announced in these pages as soon thereafter as practicable.

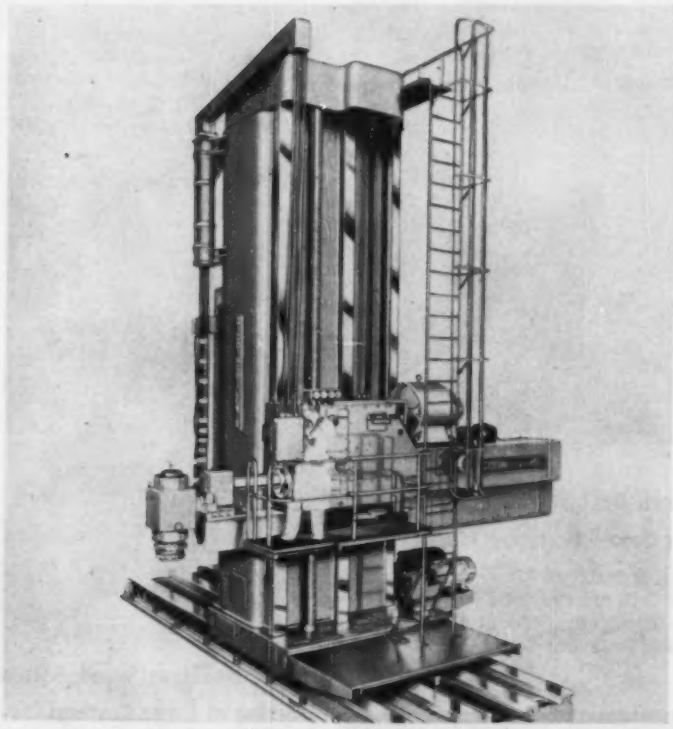
JUDGES—A group of 200 *American Machinist* readers is asked to select preferred articles in each issue. The group is a true cross-section of all readers, and changes entirely each time. Their votes, in addition to guiding the editors, select the best Practical Idea. If at any time their votes result in a tie, $25 will be paid to each co-winner. Decision of the readers will be final in each case.

REQUIREMENTS—Only items in the Practical Ideas pages are eligible, and they must be submitted directly by the originator. Do not worry about your shortcomings as a draftsman, photographer, or author—every item will be edited in accordance with *American Machinist* standards and suitable illustrative or explanatory material added where needed. Readers will judge only the finished product—in terms of its usefulness to them.

WHO MAY ENTER — Anyone may enter except employees of the McGraw-Hill Publishing Co, Inc, and those of advertising agencies or departments. Suggest to your employees that they submit ideas.

HOW TO ENTER — Send all entries to "Practical Ideas Editor," American Machinist, 330 West 42nd St, New York 36, N. Y.

New Shop Equipment
Materials and Parts



G&L Horizontals Offer More Than 20 Feet of Vertical Headstock Travel

The new 80 Series horizontal boring, drilling and milling machines have either an 8-in. or 10-in.-dia spindle and feature vertical headstock travel in excess of 20 feet. The machine illustrated is the Model 880-FUAR floor-type with an underarm. It has an 8-in.-dia spindle, 84-in. spindle underarm travel, 17-ft headstock travel, and 20-ft column travel.

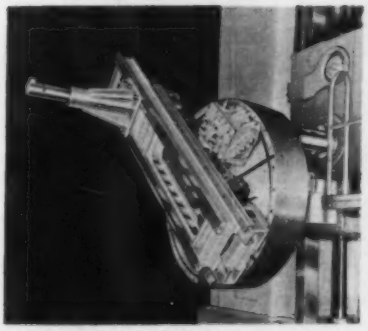
Designed for heavy-duty operation, the machines have main drive motors up to 100 hp. Four basic models are available: floor-type, floor-type with underarm, floor-type with cross-sliding column, and planer-type machines. These machines are reported to be the first of their kind to utilize an extra-heavy, specially reinforced, 3-way welded steel column. This provides the rigidity necessary for precision work with headstock travel over 20 feet.

The 80 Series features complete remote control from a swinging pendant station. All speeds and feeds and selection, engagement, and clamping of all moving units are preselected. Pushbutton positioning from the pendant permits the operator to exercise close supervision over all functions. A portable station controlling all spindle functions is provided for use where the size of the workpiece might interfere with the use of the swinging pendant.

Electronic readout system

This line has been arranged for adaptation of programmed controls including templet tracer, numerical positioning, and numerical contouring. Under numerical operation the machine will be controlled from either magnetic or punched paper tape.

An electronic readout system provides measurement of machine motions at the pendant station, offering the operator a simpler and faster means of positioning or measuring machine motions than is possible with scales and verniers. Measurements of the headstock or column position are read in digital figures to within 0.001 in. through a servo system which translates all movements up, down, forward, or backward from a given reference point. This reference point can be changed at will to orient the machine to the workpiece at any position in its full length of travel.



Continuous-feed boring and facing tool for use on a faceplate drive permits handling of work normally assigned to large vertical boring mills

Infinitely adjustable control (with direct reading meters) for all speeds and feeds is another feature of these machines. The spindle drive motor, as well as the individual feed motors for the headstock and column, have a 4:1 adjustable speed range. This provides infinitely adjustable speeds between 2 and 500 rpm and infinitely adjustable feeds between 0.5 and 120 ipm.

Other features of the line include telescopic sights for headstock, underarm, and column travel; two-way telescoping operator's platform or independently powered, elevating, operator's platform; spindle depth counter and micrometer dial; spindle handwheel for tapping; separate spindle and underarm traverse motor; and electro-hydraulic clamping throughout. A built-in thread lead device can be provided.

Gidding & Lewis Machine Tool Co, Fond du Lac, Wis

MORE DATA? Circle 51, inside back cover

Frauenthal Introduces Single-Spindle Vertical Grinder

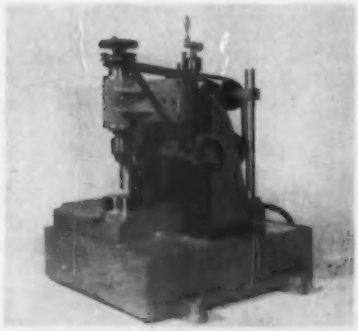
The 1200 Series single-spindle vertical grinding machine is a fixed rail design and is available in two sizes and two models. The 1224 size has a 24-in.-dia table with 36-in.-max swing capacity. The 1236/42 has a 36-in. or 42-in.-dia table with 48-in.-max swing capacity. The compound swivels 45° either side of center. The grinding spindle, in turn, swivels 90° either side of slide center.

Each size is available with either a belt driven grinding spindle or a direct connected grinding spindle to suit a particular application. The machines are designed for feed, traverse, and reciprocation in both horizontal and vertical directions. All operating controls are mounted in a pushbutton control panel.

The cross rail has a center mounting with adjusting screws to permit exact alignment between grinding spindle and work spindle. Spindle speeds are infinitely adjustable from 2 to 235 rpm on the 1224 size and from 2 to 200 rpm on the 1236/42.

Frauenthal Div, Kaydon Engineering Corp, Muskegon, Mich

MORE DATA? Circle 52, inside back cover



Bench Drillpress Offered For Small Precision Work

Unit is designed for operations where the drill must be held very accurately in a collet. Model illustrated is using a Jacobs No. 1A drill chuck; it also takes standard Magnus-Elect collets with max run-out of 0.0002 in. Special accuracy (0.0001-in.) collets can be supplied.

Drive is supplied by a 1/12-hp, 60-c, single-phase, 1725 or 3450-rpm motor with two step pulleys. Dimensions are 13 x 13-in. base; max height from table to top of column, 15 in.; throat depth, 3½ in.; max height from top of table to headstock, 4 in. Column has a micrometer screw and can be adjusted 2 in. in thousandths of an inch.

F W Derbyshire, Inc, 157 High St, Waltham 54, Mass

MORE DATA? Circle 53, inside back cover

DoAll Machines Speed Destructive Testing of Large Castings

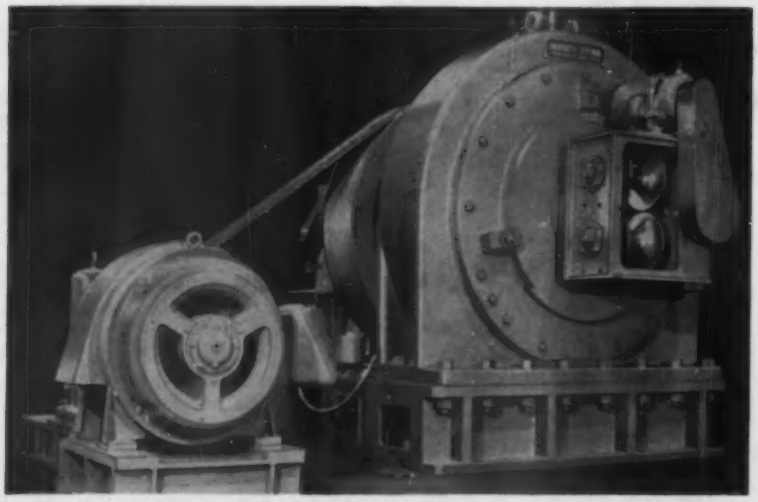
These machines are designed for rapid sectioning of all iron, steel and aluminum castings generally in use. Engine blocks and similar parts with complex cores can be accurately inspected only after slicing them apart. These two machines are designed particularly for this type of work.

The smaller machine is a Model 36-2 with 25-in. work height and with a 48-in.-stroke table that travels on Thomson linear ball bushings. The larger machine (illustrated) is a Model 36W with 36-in. work height and with a 48-in.-stroke table running on automatically lubricated V-ways.

On both machines the saw band can be changed whenever necessary without disturbing the setup. Smooth, positive hydraulic table feed provides infinitely adjustable rates from one inch to eight feet per minute. Table strokes up to 96 in. and work loads up to 5000 lb are obtainable in these designs.

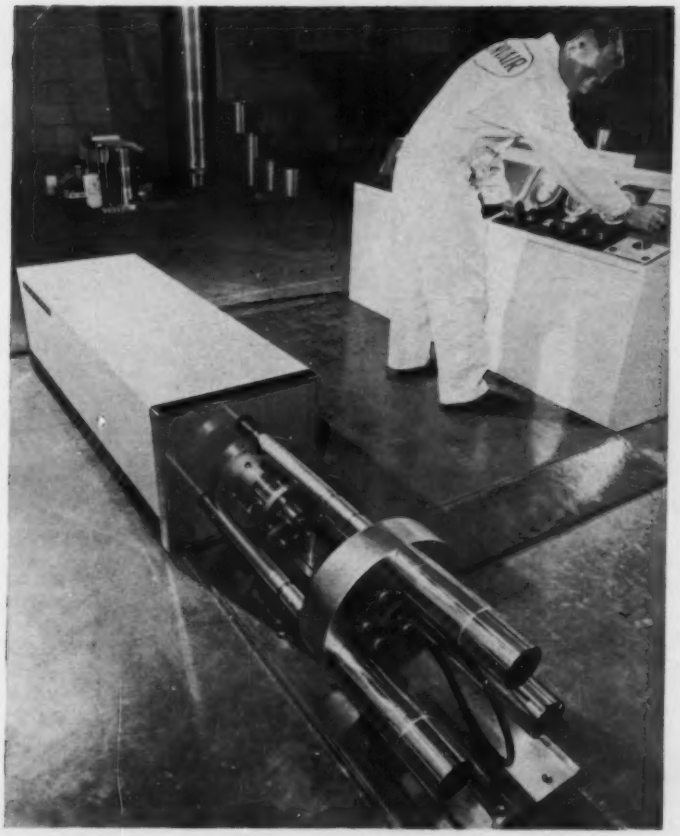
DoAll Co, Des Plaines, Ill

MORE DATA? Circle 54, inside back cover



SWAGING MACHINE, No. 916, believed to be the largest of its type, produces 8-in. saran-lined pipe. An unusual feature of this machine is the passing of pipe lengths completely through the swager spindle. Machine has power driven rolls at both entrance and exit. It has a 16-in. die length; swages at approx 15 fpm; delivers approx 2000 hammer blows per min at 88 rpm. Swager is 8 ft high and covers a floor area of 16 x 12 ft. With different dies the machine can handle pipe down to 2 inches—*Abbey Etna Co, Perrysburg, Ohio*

MORE DATA? Circle 55, inside back cover



Thin-web extrusions and zero-draft forgings are typical of difficult parts made by Dynapak. Parts are shown full size

High-Energy Pneumatic Machine Tool Forms Metals at "Explosive" Velocities

Dynapak, Convair's new metalworking machine tool, is a multi-purpose, high-velocity, high-energy-rate machine that applies a long-known but seldom used law of pneumatics to the forging, forming, extruding, compacting, shearing and blanking of metals and other materials.

Because of the extremely high pressures generated, Dynapak can produce parts that cannot be made in any other way. For example, it extrudes parts with web thickness only one-hundredth of an inch; forges to zero draft angle, and produces smooth, close tolerance surfaces that require little or no finish machining. Yet the machine is only a fourth as large and heavy as conventional machines designed to do similar work (*AM*—Apr 23 '56, p124).

High velocity

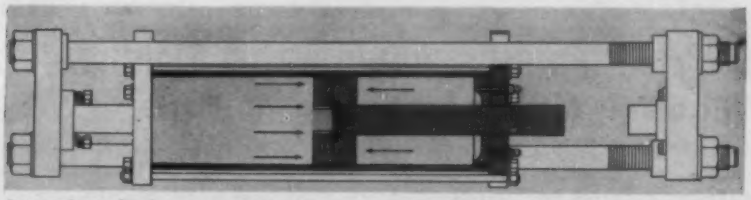
One theory of high-velocity metalworking is that many metals—including the high-strength, high-temperature steels—exhibit hydrodynamic behavior (that is, they flow as if they were plastic) when worked at high velocities, with the application of high energy rates and corresponding pressures. Dynapak is designed to take advantage of this "plastic flow."

High-velocity forming has been the subject of research for several years, but the driving force was usually explosives. These new machines are pneumatically powered.

Pneumatic operation

Dynapak combines Convair's HYGE actuator, a pneumatically energized actuating mechanism used previously for aircraft and missile shock testing machines, and a Mark II dynamic reaction frame which provides a plate to react the load against. The HYGE is a self-triggering, gas-powered ram capable of delivering the energy potential of 2000 psi of gas instantaneously to a free piston-column assembly. Its output energy range is almost infinitely wide. Thus the horizontally positioned piston may be used either as a free impact tool generating several million pounds of load on a workpiece, or it may be used as a sustaining thrust device to produce several hundred thousand pounds of force at velocities up to 400 feet per second. Velocities can be controlled to one or two feet per second.

The piston stroke (see diagram, left) is so fast the motion cannot be seen with the naked eye. The form-



Actuating device is a cylinder separated into two chambers by an orifice plate. In chamber at left, high pressure gas is stored. Relatively low gas pressure in right chamber forces piston against orifice plate, and a seal in the piston face isolates all of piston surface area from high pressure gas except a small area surrounded by the seal. The machine is now set to "fire." Application of slight additional pressure to high pressure chamber (left) starts piston moving and permits high pressure gas to push against entire piston face. The tremendous pressure differential created provides "explosive" driving force

ing action is measured in milliseconds. Depending upon the size of the machine, 40,000 to 1,500,000 ft-lb of energy are available. Energy at this level would shatter any rigidly held die; thus the use of a dynamic frame. The plate on which the die is mounted has inertia, and therefore can be relatively light. A plate that weighs 300 lb can hold two million pounds of load. The workpiece itself absorbs much of the energy.

But to accomplish the work, additional energy must be applied—and dumped into the plate. To take up this additional load, the reaction plate is tied by three heavy bars to a sturdy plate at the rear of the actuator. This plate, in turn, is connected to a shaft and piston housed within the high-pressure gas chamber. On firing, part of the load is transferred to the rear plate and piston assembly, which in turn is cushioned by the 2000-psi pressure in the storage chamber. In effect, the machine is its own shock absorber. To decrease the stroke velocity without reducing the energy applied to the work, the machine is equipped with plates of varying thickness.

The piston is returned to seal position through the action of a high-speed pump which injects hydraulic fluid into the piston chamber, again forcing the piston down against the orifice plate.

Capacity

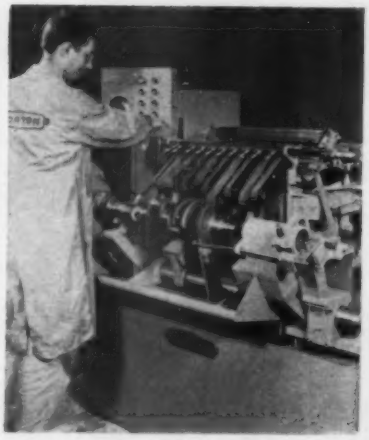
The machines are available in three standard sizes. Model 600 (illustrated) has a 6-in. bore; measures 2 ft high, 2 ft wide, 9 ft long; and delivers 40,000 ft-lb of energy. Model 1200 has a 12-in. bore; measures 3 x 3 x 12 ft; and delivers 160,000 ft-lb of energy. Model 1800 has an 18-in. bore; measures 4 x 4 x 14 ft; and delivers 360,000 ft-lb of energy. A machine with a 36-in. bore can produce 1,500,000 ft-lb of energy. Work platens are 10 in., 20 in., and 36 in. respectively, for the Model 600, 1200 and 1800. Cycle time of the 6-in. and 12-in. models is once every 30 seconds, that of the 18-in. model once every 60 seconds. Sequencing of the firing cycle is set by a single dial on the control console.

Other advantages

The machines are simple to operate and are readily converted to any desired operation. In many cases, no lubricants are needed nor must the dies be heated. And dies may be made of ordinary steel.

Convair Division of General Dynamics Corp, San Diego 12, Calif

MORE DATA? Circle 58, inside back cover



Crankshaft Lapping Machine Adaptable to Other Parts

No. 31 Crank-O-Lap, designed to produce fine surface finishes by means of coated abrasive strips on external diameters of automotive crankshafts, is also suited to improving the finish on other types of parts.

Machine laps pins and bearings simultaneously in an automatic cycle. Head and foot stocks are carried on a swing frame mechanism that presents them at hand-high level for easier handling. After operator has placed crankshaft in V-blocks, push-button automates the machine until unloading. Unit can be adapted to automatic work loading and unloading devices for fully automatic operation if desired.

Norton Co, Worcester 6, Mass

MORE DATA? Circle 59, inside back cover

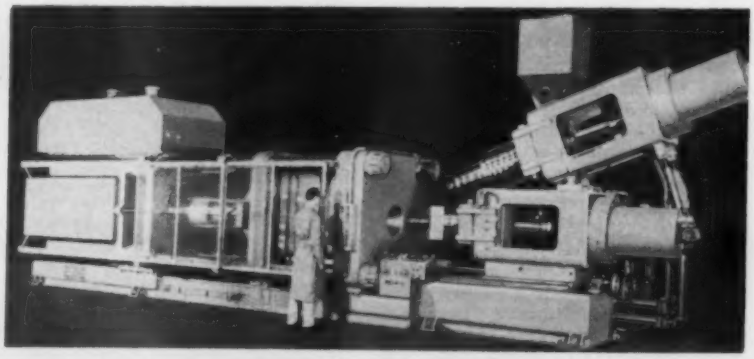
Micro-Finish Milling Cutters Designed for Aluminum, Magnesium

Cutter, tradenamed Microcut, has been developed for milling of aluminum and magnesium to tenths, holding a 30 mu-in. finish or better, and is designed to eliminate many grinding and hand-finishing operations.

Tools have highly finished cutting edges and polished flutes. They are available in inserted, wedge, and solid design, including HSS, cast alloys, and carbide.

O K Tool Co, Milford, NH

MORE DATA? Circle 60, inside back cover



H-P-M Preplasticizing Injection Molding Machine Makes Large Plastic Parts

Model 1500-P-300 injection molding machine for plastic parts up to 300 oz is a 1500-ton unit with an injection rate of 6640 cu in. of material per minute. Features include mold mounting area of 48 x 72 in.; full hydraulic mold clamp with 60-in. stroke; 106-in. daylight.

Combined operations of a newly designed three-way rotary material control valve and an adjustable stop nut are said to facilitate exceptionally high speed production of quality, minimum weight parts with absolute control over shot weight.

Hydraulic Press Mfg Co, Div of Koehring Co, Mount Gilead, Ohio

MORE DATA? Circle 61, inside back cover

CIRCLE 270 READER SERVICE CARD ▶

Stuart

Productive Lubrication

FOR PROFIT-MINDED PRODUCTION MEN

VOL. 1, NO. 1 NOVEMBER 1958

High-lubricity soluble oil helps Bower grind better bearings faster

Stuart's free-cutting Dasco super soluble hikes production. Fine finish trims honing time.

Experience at Bower Roller Bearing Division, Detroit, proves some interesting points about cutting fluids for grinding 52100 steel.

Stuart's Dasco super soluble base is used in Bower's central system at 30:1 for grinding cups and cones for all types of tapered and straight roller bearings. It helps attain surface finishes up to 20 microinches, reducing the amount of honing required. In addition, Dasco super soluble contributes other important advantages: decreased cycle time per piece, reduction in annoyance

of rancidity, and longer solution life than with other cutting fluids tested. Vapor and dirt are reduced.

Stuart's John S. Dalton, with Spike Dunaway, general grinding foreman, and William Half, both of Bower, solved a difficult grinding problem on tough bearing steel with Dasco super soluble base.

Answer to Stress-Free-Grinding

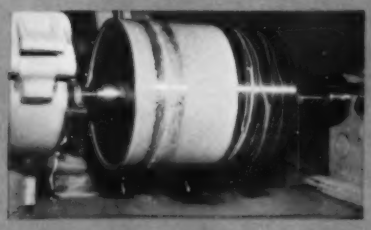
Tolerances at Bower as close as .0005 in. on both OD and ID are not unusual and even closer limits are required on some jobs. Extra-high detergency and free-cutting action are just as vital as cooling to prevent heat-checking, loss of accuracy due to heat distortion, and costly downtime for wheel dressing. Wheel grits vary from 60 to 120, and some wheels may cut up to 1000 pieces before dressing.

Excellent Automation Cutting Fluid

In this shop, which works two-shift operation, Dasco super soluble helps increase production when used in a central system serving over 100 different grinding machines because downtime for maintenance, clean-out, and recharging the machines is at a minimum.

Dasco super soluble base is a compound formulated for metal-working operations too difficult for ordinary water-mix fluids, yet not suited for straight cutting oils. It has a sulphochlorinated fatty oil base, which provides an excellent combination of antiweld and lubricating properties for turning, drilling, milling, sawing, boring, and reaming.

CODOL proves versatile on fine-finish job



Finish grinding IBM's all-important "memory unit" (above) dramatically illustrates the versatility of Stuart's Codol liquid grinding compound. The 10-in. OD monel drum rotor is coated with copper and final-plated with a cobalt-nickel outside coating that retains and categorizes all information from the data-processing machine. Dirt, scratches, or dimensional inaccuracies could cause serious errors. Each coating is precision ground using Stuart's Codol to lubricate and keep the wheel clean. About .008 in. is removed in each step, and concentricity is held within .00025 in. Codol's extreme cleanliness is most important, followed by cooling efficiency, and carefully balanced surface tension that floats away "chips" to prevent scratches.

MORE PL FACTS ▶

Productive Lubrication

Low tool lubrication cost a danger signal

Any cost which looks low and stays low could be a "booby trap" and should be re-evaluated periodically by production management.

This does not imply that a higher cost for a cutting fluid necessarily gives you the best combination of qualities for a particular job. Sometimes the low-priced product outperforms the higher priced product. But, there is a basic fallacy in purchasing and budgeting practice today which often defeats your purpose of profitable operation, particularly with today's lower volumes. Here's what we mean.

In a very few instances can a cutting fluid be considered a machine maintenance item, or cost, or an overhead burden to be allocated by department in relation to its consumption. If the cutting fluid doesn't protect the cutting tool, you're better off machining your pieceparts dry.

Thus, "tool lubrication cost" is as integral a part of tool replacement cost as the cutting tools, resharpening, and downtime for changing and resetting tools.

COST (per week)	Cutting Fluid "A"	Cutting Fluid "B"
1. Tool changing cost	$ 1.20	$ .30
2. Tool regrinding cost	$239.40	$59.85
3. Tool depreciation cost	$145.00	$36.25
4. Tool lubrication cost	$ 1.77	$ 1.89
Total tool replacement cost	$387.37	$98.29
1. Tool replacement cost per piece	$ .32	$ .08
2. Machining cost per piece	$ .24	$ .20
Total cost per piece	$ .56	$ .28

Determine your tool lubrication cost per piece (along with your other tool replacement costs) and you will find it so small that only performance really counts.

Cost of cutting fluid is not always in the price. Here's why. In one case studied, a 12c a gallon "higher price" increased the number of pieces per sharpening 300%, reducing the average number of tool regrinds 75%, and the number of new tools required was reduced 95%. This improvement cut tool replacement cost from $387.37 to $98.29 per week—all for an added expenditure of just 12c a gallon for an improved type of cutting fluid.

An annual increased investment of $6.24 to get an improved quality product yielded a yearly saving of $15,032.16.

The chart illustrates the economies inherent in cutting fluid evaluation. On this job with tool replacement cost reduced from 32c to 8c per piece, the manufacturer could afford to increase machine speed from 720 to 980 ft per min. The part cost was slashed from 56c to 28c — a 50 per cent cost reduction.

Advantages of THERMEX compounds stand out on tough valve forging job

High lubricity solves galling and welding problems, low burning rate protects operator

Galling and welding are eliminated in the plant of one of the automotive Big 3 by using a spray application of Stuart's Thermex "CMF"

forging compound to produce 3800 exhaust valves per eight-hour shift with manual load and unload and 10,000 V-8 intake valves per shift automatically. Out of a full-shift production of over 38,000 exhaust valves, only 3.7 per cent were rejected. On another run of 24,260 valves, rejects were only 2.25 per cent, and on a third run of 15,893 V-8 valves, rejects dropped to 1.55 per cent.

The plant's general superintendent reports Thermex "CMF" has a lower burning rate after the initial flash, making it ideally suited for insert die valve forging . . . particularly on the automatic machines

operating at 40 per cent greater stroke capacity. Other forging compounds burned with increased intensity or continuity, creating difficult working conditions.

The answer is a high graphite content in the lubricant. Thermex "CMF" has a high percentage of graphite, contains active sulphur to eliminate galling and welding, and provides efficient lubrication under the high temperature operating conditions of this forging operation.

METALWORKING LUBRICANTS
D. A. STUART OIL CO., LIMITED
2727 South Troy Street, Chicago 23, Illinois
CANADIAN D. A. STUART OIL CO., LIMITED
P. O. Box 430, 43 Upton Road, Scarborough, Ontario, Canada

Phone Your Stuart Service Center

BAYONNE, N. J. HEmlock 7-0151
DETROIT, MICH. TYler 7-8500
CHICAGO, ILL. Bishop 7-7100
HARTFORD, CONN. JAckson 7-1144
CLEVELAND, OHIO PRospect 1-7411
TORONTO (Scarborough) PLymouth 7-3227

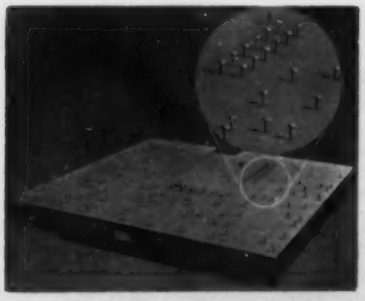
Compact 3-Way Angle Vise Has 4-in. Jaw Capacity

Universal Model 1A for compound heavy, medium, or light-duty applications incorporates new wedge-type movement locks that assure set-up rigidity up to 3000 lbs torque loading.

The 5¼-in.-high unit has a base 12 in. long and 8⅝ in. wide. Cradle is more rigid than previous models and uses a more massive dovetailed design and cradle support. All angular adjustments and locking are quickly accomplished with a single hex wrench. Graduations, accurate to ± 15 minutes, are marked on stainless steel rings for easy reading. Three separate angular adjustments are provided: 360° rotation of the base; 90° vertical range cradle; and 360° rotation of jaw assembly.

Wesson Co, 1220 Woodward Heights Blvd, Ferndale 20, Mich

MORE DATA? Circle 62, inside back cover

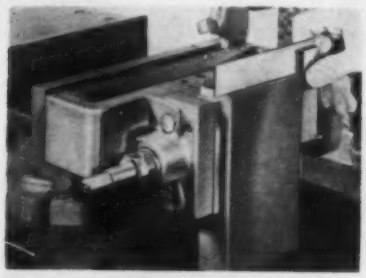


Granite Surface Plates Available With Threaded Inserts

Diabase (black granite) surface plates are now available with threaded steel inserts, to facilitate the attachment of various components to the plate. The inserts are so designed that, when they are cemented into holes drilled in the granite, they are stronger than the machine screws used. Minimum spacing between centers of two inserts, or between the center of an insert and the edge of the plate, is three times the diameter of the machine screw used. The plate illustrated is 48 x 48 x 8 in. and has 147 threaded inserts.

Rahn Granite Surface Plate Co, 644 N Western Ave, Dayton 7, Ohio

MORE DATA? Circle 63, inside back cover



Shaper Vise Attachment Simplifies Squaring of Work

Squarite permits inexperienced operators to positively square work by simply securing piece into the vise attachment. Long pieces can be easily end-shaped to positive length because attachment clears the main shaper table allowing work to extend to the floor.

In addition to saving finish-grinding time, micrometer and vernier measurements of over-all dimensions can be taken without removing work from the vise. Device permits changing from length-wise to end-shaping without changing position of vise or raising and lowering of main table. Jaw lengths are from 10 to 15 in.; jaw openings 6 to 8 in.

Heinrich Tools, Inc, Racine, Wis

MORE DATA? Circle 64, inside back cover

12-Jaw Universal Chuck Holds Large-Diameter Missile Parts

Chuck is 46 in. in diameter and can be used singly on vertical lathes, or in pairs on horizontal lathes for parts, subassemblies, and complete missile tank assemblies.

Concentric expanding and contracting action of the 12 equally spaced universal jaws is particularly useful for rounding out and holding thin-walled sheet metal missile tanks and parts for trimming, facing, turning, and welding operations. Designed to perform to close tolerances, chuck is rated to repeat within 0.002-in. TIR at the diameter to which the top jaws have been machined. Unit can be furnished with soft blank top jaws which user can machine to fit his part, or with special shaped top jaws made to specifications.

Horton Chuck Division, United-Greenfield Corp, New Haven, Conn

MORE DATA? Circle 65, inside back cover

SMALL BORE GAGES, Set E4 added to Diatest line, cover diameters from 0.820 to 1.130 in. Range previously covered .057 to 0.828 in. (AM-April 21, p250). Gages are accurate to within 0.00008 in. and all sets overlap in size to assure complete range *—Foster Supplies Co, 6122 Milwaukee Ave, Chicago 46, Ill*

MORE DATA? Circle 66, inside back cover

2-Broom Power Sweeper Turns Within Its Radius

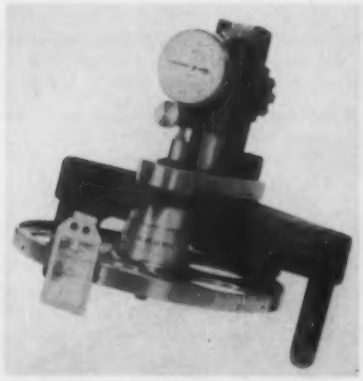
Task Master 42 with integrated drive, transmission and steering assembly has a 5-ft 6-in. turning radius. Stabilized floating main broom handles light or heavy sweepage, allows broom to sweep out depressions, assures floating action on irregular

surfaces. Spring-loaded counter balancing unit stabilizes pressure on the side broom and permits adjustment to meet all sweeping conditions

Sweeping swath of the main broom is 42 in., side broom, 70 in. Unit's speed is ½ to 15 mph; hopper capacity is 13.5 cu ft, ½ ton. Length is 85 in.; width, 52½ in.; height, 50¼ in.

Patch & Kase Corp, 159 S Irwindale Ave, Azusa, Calif

MORE DATA? Circle 67, inside back cover



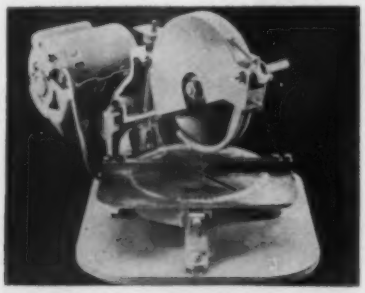
Testing Device Checks Dial Indicator Accuracy

Barrel of device is accurate to 30 millionths of an inch, according to US Bureau of Standards test. Graduations on its 8-in.-dia ring were found to be accurate to 2 sec of an arc of the circumference. Tester proved capable of checking indicators with ranges up to 1 in., direct to 0.0001 in.

Portable instrument has a cast iron base with three point suspension tilted to proper angle for easy reading.

B C Ames Co, Waltham, Mass

MORE DATA? Circle 68, inside back cover



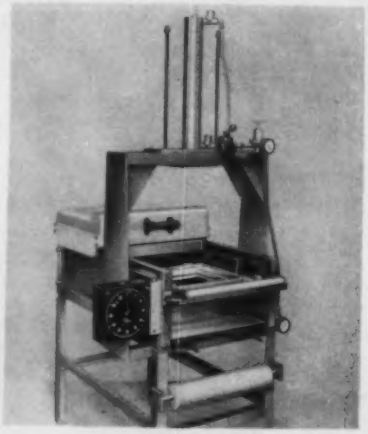
New Portable Chop Saw Added to Irvington Line

Model 29 is designed for all types of cutoff jobs on nonferrous metals where accuracy within thousandths of an inch is required. Unit can make straight, angle, or compound cuts; no counterweight adjustment is needed.

Saw table is calibrated in degrees to aid angle setting. V-belt and 9-in. saw blade (removable) are guarded for safety. Model is furnished with ¾-hp motor, 110/220 v, single phase.

Irvington Machine Works, 1808 N E 7th Ave, Portland 12, Ore

MORE DATA? Circle 69, inside back cover



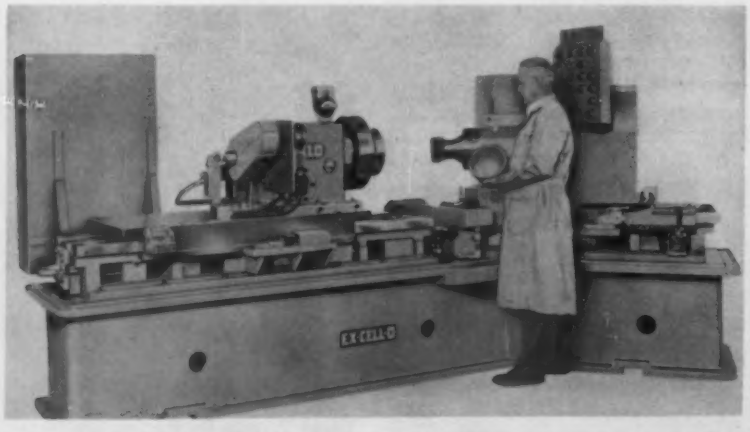
New Accessories Available For Lab-Vac Sheet Former

Lab-Vac thermoplastic forming machine for straight vacuum forming on female molds, or drape forming on combination male and female molds, can now be used for plug forming. Plug forming attachment is available for applications where deep-draw forming with minimum side wall taper is required. Speed and depth control of plug stroke and manual air-cushioning controls are incorporated for maximum operating efficiency.

Additional accessories offered include auxiliary clamping frames for sheets smaller than 18 x 18 in.; roll feed attachment that permits use of 18-in. material slit from a 36-in. roll stock, thereby saving approx 18 sq in. of material for each forming operation; large dial clock calibrated in seconds to provide closer timing control.

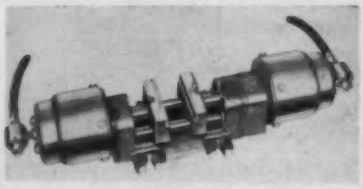
Auto-Vac Co, Div of National Tool Co, 1984 State St Extension, Bridgeport, Conn

MORE DATA, Circle 70, inside back cover



ALUMINUM HEMISPHERES from 6 to 16 in. in dia have ODs and IDs rough and finish machined on this custom turning machine. Special work spindle permits unit to hog out material at rate of 15 cu in. per min at depth of cut of ⅛ in. Tolerance of less than 0.0001 in. on hemisphere radii and approx 0.0001 in. total on wall thickness is maintained on finish cuts. Surface finish of 10 rms or better is obtained—*Ex-Cell-O Corp, 1200 Oakman Blvd, Detroit 32, Mich*

MORE DATA? Circle 71, inside back cover



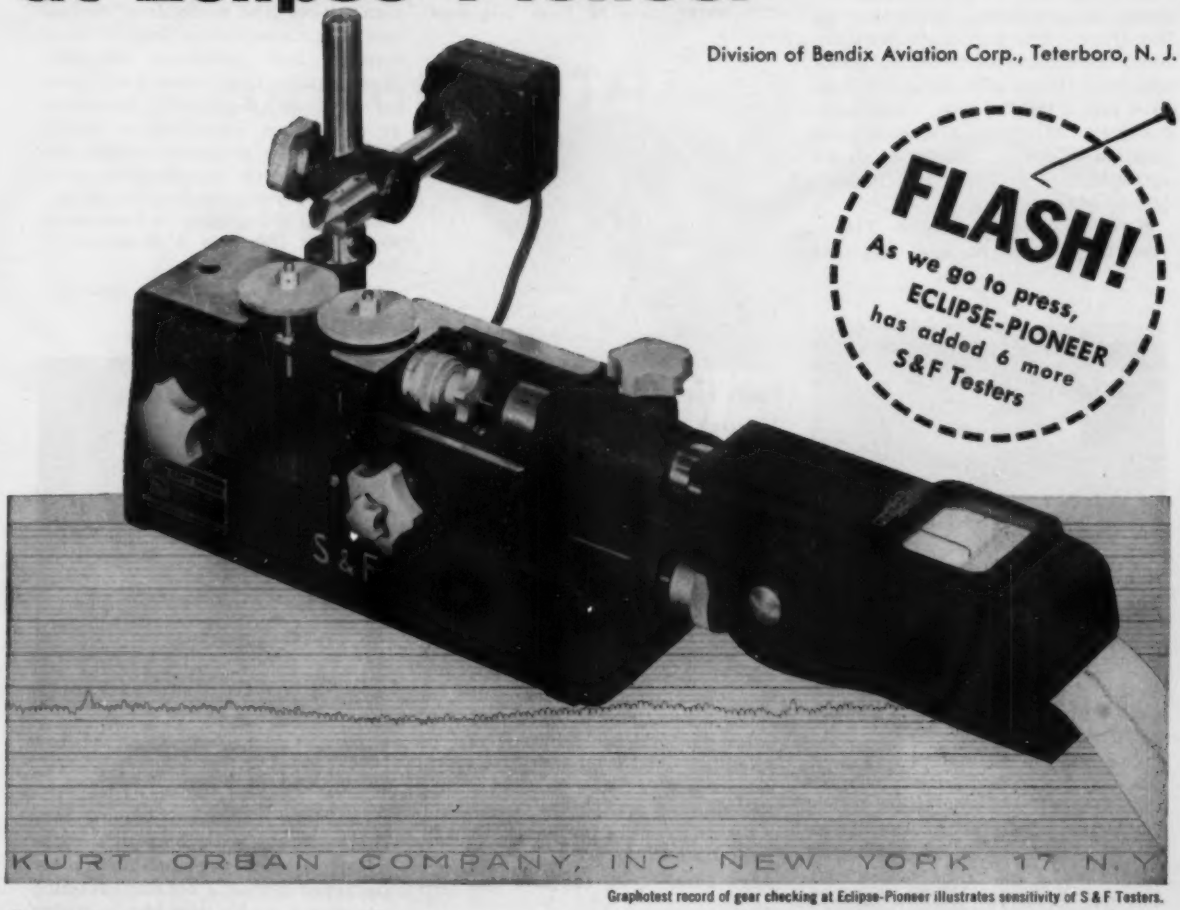
Self-Centering Air Vise Has 4-in. Max Jaw Travel

Model 11 is designed for holding parts varying in size or shape when work requires location of a center or other pre-determined point; unit finds this point automatically.

Two opposing jaws are actuated

now it's 13 S&F gear testers at Eclipse-Pioneer

Division of Bendix Aviation Corp., Teterboro, N. J.



Graphotest record of gear checking at Eclipse-Pioneer illustrates sensitivity of S & F Testers.

because there's no gear tester as accurate as the S & F

Gear specifications for Eclipse-Pioneer's directional gyros call for Precision Class 3 tolerances—tooth-to-tooth error of .0002", total composite error of .0003".

Eclipse-Pioneer found that the S & F provided the *extra* measure of sensitivity which assured that their gear production *really* held to these tolerances. It did the job faster, too. Set-up and change-over time was only a fraction of what it had been with other instruments.

That's why Eclipse-Pioneer recently added three new S & F testers—now has a total of 13 in active operation.

And that's why scores of other plants are changing over to the S & F—to make sure that the gears they make—or buy—are as accurate as they're supposed to be.

Ask us to show you why the S & F—*guaranteed to repeat within .00001"*—is revolutionizing gear checking. Or talk to the S & F user near you; we'll send you his name.

KO CO., INC. PRECISION MACHINERY

KURT ORBAN COMPANY, INC.

36 Exchange Place, Jersey City 2, New Jersey

directly by diaphragm air cylinders on both ends of the vise. Jaw movement is synchronized within a tolerance of 0.001 in. by gear and rack in the base. No pressure is transmitted through the centering mechanism, guaranteeing uniformity of jaw travel. The 4-in.-wide jaws are infinitely adjustable to 4⅛-in. opening. Max travel after setting is 2 in. each jaw, a total of 4 in. Jaws automatically adjust simultaneously in relation to center. Length of stroke is controlled by locking collars on piston rods.

Heinrich Tools, Inc, Racine, Wis

MORE DATA? Circle 72, inside back cover

Side-Arm Extractor Added to Press Unloader Line

Automatic press unloader has overall length only 18 in. greater than its stroke of 8 ft. Compact unit is supplied with a wheel-mounted portable base.

Jaw assembly (standard Iron Hand jaw) can be moved on the frame so that it can operate on either left or right side; controls are centrally located. Assembly is adjustable for height and angle of extraction. Additional features include a self-cleaning, angular track; chain drive; and standard components for easy interchangeability. Unit requires only plugging-in to start operation.

Sahlin Engineering Co, PO Box 289, Birmingham, Mich

MORE DATA? Circle 73, inside back cover

High Purity Nitrogen (99.99%) Produced by New Dry Process

New nitrogen generator packaged unit has been introduced, completely piped and wired for production of nitrogen atmosphere by combusting a mixture of air and natural gas, or any manufactured gas such as butane, propane, water gas, or coke oven gas.

Atmosphere produced can be used for any application where a high nitrogen, CO_2 free, dry atmosphere is required, such as in the heat treating and melting fields of the metals industry.

Lindberg Engineering Co, Gas Process Div, 2450 W Hubbard St, Chicago 12, Ill

MORE DATA? Circle 74, inside back cover

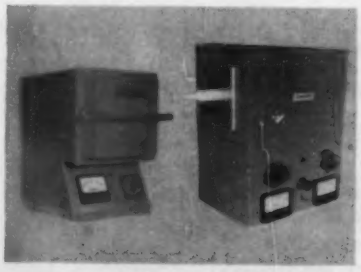
Parts Feeder Made Jam-Proof Through Use of Live Rollers

Hoppermatic Model R incorporates rollers to feed the product instead of the conventional slide rails; design eliminates jamming of parts in the discharge track.

Unit combines the cast drum of the standard Hoppermatic, which has built-in universal pick-up pockets, with the driven rollers to achieve higher feed rates than were previously possible. Production rates for small screws run in excess of 1000 parts per minute. Machine can be provided with mechanical finger to release one or more parts at a time for counting.

US Engineering Co, 40-26½ 22nd St, Long Island City, NY

MORE DATA? Circle 75, inside back cover



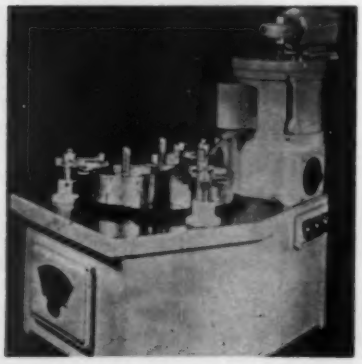
Lindberg Engineering Offers Two Laboratory Furnaces

Model NEB-4 box furnace (left) is a compact, self-contained unit designed for laboratories where work loads are moderate. Applications include fusions, ignitions, assaying, drying precipitates, and heat-treating small parts. Max operating temperature of 1850 F is reached within 70 minutes. Effective work chamber size is 4 in. wide, 3⅞ in. high, and 10 in. deep.

Tube furnace on the right is designed to meet requirements of all combustion tube methods of carbon and sulfur analysis on ferrous, nonferrous, and petroleum samples. Manufacturer claims that it will provide lowcost, dependable operation at continuous temperatures up to 2650 F. Units available in one and two-tube models are adaptable to 1, 1¼, and 1½ in. combustion tubes.

Lindberg Engineering Co, Laboratory Equipment Div, 2444 W Hubbard St, Chicago 12, Ill

MORE DATA? Circle 76, inside back cover



Spitfire Lapping Machine Introduced in Bench Model

Gyro-Matic 12-in. flat lapping machine operates with company's workholder retainer rings that guide piece parts and permit a constant rotating movement which provides a truing action to keep lapping surface completely flat.

Abrasive selector allows rapid selection of correct flow; positive flow to working area is provided by a newly designed feed line. Full voltage oil-tight heavy duty control stations are incorporated.

Spitfire Tool & Machine Co, 2931 N Pulaski Rd, Chicago 41, Ill

MORE DATA, Circle 77, inside back cover

Teflon Coatings Can be Applied To Heat-Sensitive Materials

The Emralon family of dispersions is composed of specially processed tetrafluoroethylene (TFE, Teflon) particles suspended in a liquid carrier. Formerly, applications of Teflon were limited to materials which could withstand the high tempera-

V-R Multiple tooling cuts at BOTH 450 and 113 s. f. p. m.

How V-R Carbide and TANTUNG® cast alloy gang up to solve cutting problems

PROBLEM: How to bore 2" I.D. at 113 SFPM while turning 8" O.D. at 450 SFPM.

SOLUTION: A V-R toolholder and throw away insert will perform perfectly on the 450 SFPM O.D. but the 113 SFPM boring speed demands the cutting qualities of V-R TANTUNG cast alloy. TANTUNG is especially engineered for speeds between carbide and High Speed Steel.

V-R Carbide and TANTUNG make a perfect tooling team to solve this and many other cutting problems. Ask your V-R Representative or write for complete information. V-R Engineers will be glad to work with you on all of your cutting problems.

25 YEAR

V-R® **Vascoloy-Ramet corporation**

PRIME MANUFACTURERS OF REFRACTORY METALS ENGINEERED FOR THE JOB

CT-702

830 Market Street • Waukegan, Illinois

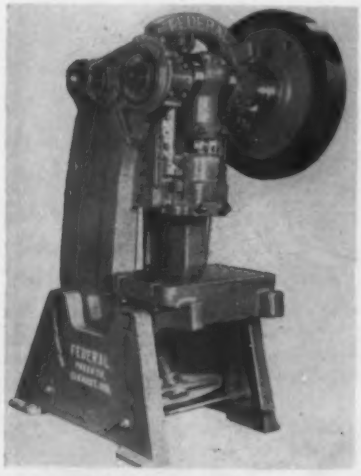
ture (over 700 F) necessary for sintering. Emralon dispersions can be cured at 300 F or even less.

Material should be applied with a spray gun using an air pressure of about 35 to 50 psi. This is followed by air drying, or infra-red, or oven curing, depending on the Emralon used. Normal film thickness is about 0.6 mil.

Emralon 310 uses a phenolic binder; it can be cured in one hour at 300 F. Emralon 320 is air drying and is designed for use on materials even more sensitive to heat or for use where baking is not possible.

Acheson Colloids Co, Port Huron, Mich

MORE DATA? Circle 78, inside back cover



Federal OBI Presses Feature Heavier, One-Piece Frames

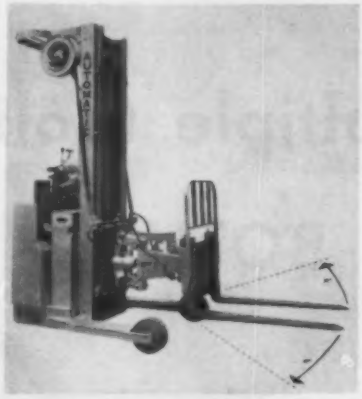
Featuring heavier, one-piece cast-iron frames, this line of open-back, inclinable presses is available in both flywheel and back-geared models. Model No. 5 (illustrated) has a capacity of 56 tons; other in the line range from 7 to 100 tons.

Several new structural features are included: heavy columns are reinforced both inside and outside from below bolster up beyond the "C" to the bearing area; press top is an integral part of the frame and supports the bearings; bearing caps are split vertically and rest in the reinforced frame.

Other features include oversize crankshaft; solid, web-type flywheels; long V-ways and gibs; non-repeat safety clutch; and a front-operated reclining mechanism.

Federal Press Co, Division St, Elkhart, Ind

MORE DATA? Circle 79, inside back cover



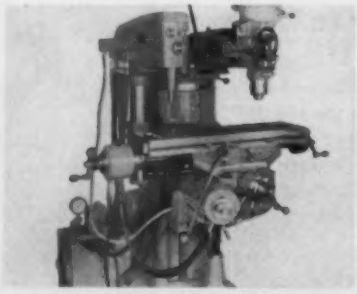
Swinging Forks Speed Truck Operations in Narrow Aisles

Transveyor Swing Reach truck has forks which reach out for the load and swing in unison, right or left of center up to 30°. Truck is available in 2000, 3000 and 4000-lb capacities. The swinging fork feature eliminates the need for positioning the truck to pick up a load. An important feature when working in narrow aisles.

Truck has a maximum lift height of 130 in. from a collapsed mast height of 83 in. A tilt device is available as an optional feature. Because the base arms do not enter rack sections, the truck can be used with any existing rack installation.

Automatic Transportation Co, Div of Yale & Towne Mfg Co, 149 W 87 St, Chicago 20, Ill

MORE DATA? Circle 80, inside back cover



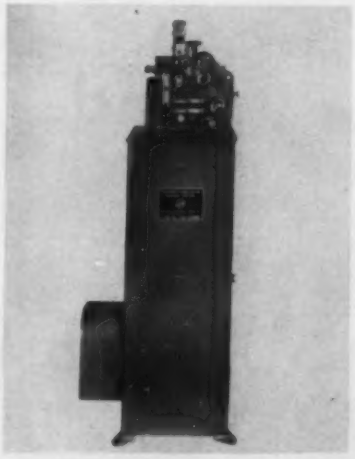
Hydraulic Duplicating Attachment Has Automatic Scanning Cycle

The Scan-O-Matic can be installed on any standard mill. Tracing stylus automatically follows the contour of a master regardless of whether straight walls, angles, or curves are being cut; deflection of stylus always remains the same. The system does not reduce the original range of the machine.

Adjustable stops, operable from either the motion of the table or of the knee, trip the table reversing valve at the end of each stroke. At the same time an indexing motor cross feeds the work for a new cut. Cross feed is adjustable in increments from 0.0025 to 0.150 in. Adjustable depth stop regulates the depth of each consecutive cut. The attachment can also serve as a power feed for regular milling operations.

Waterborg Machine Co, 2830 Rapids Dr, Racine, Wis

MORE DATA? Circle 81, inside back cover



Automatic Spring Coiler Forms Right- and Left-Hand Springs

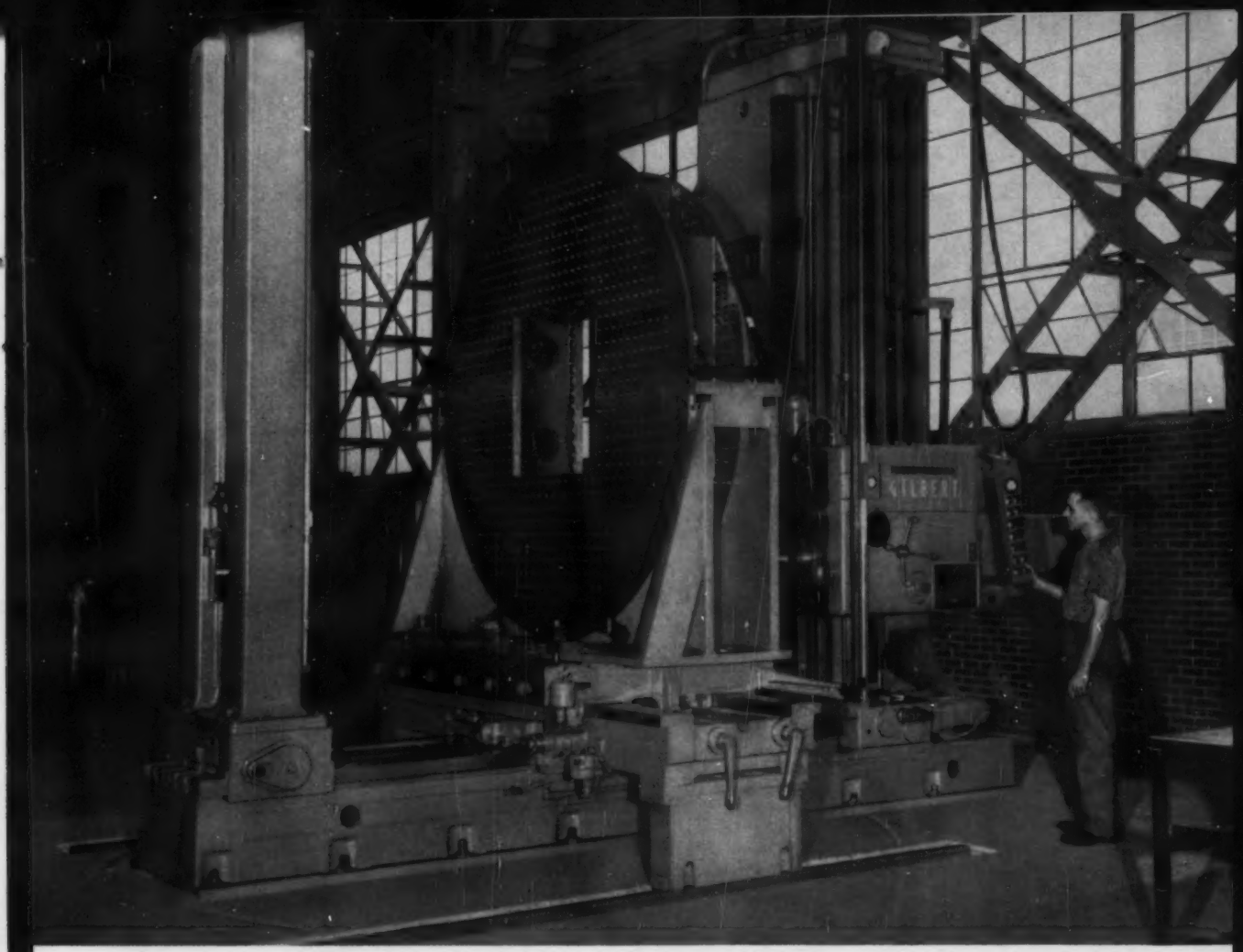
This automatic spring coiler can produce a wide variety of springs with round wire without any special equipment or arbors. The machine has simple adjustments on its face for pitch, diameter and length of spring. Both right- and left-hand springs can be formed with standard equipment.

For special shapes all adjustments can be made just as easily as for standard springs once the special cam is provided. Special tooling will permit the use of square, oval, flat, plastic coated and enameled wire.

The standard machine is equipped with a ¾-hp motor, is capable of handling wire from 0.005 to 0.040 in. in diameter, and can produce coils from 0.045 in. minimum ID to 1¼ in. OD. Larger coils require special tooling. The machine can coil 40 to 280 in. per minute and has a max cutting cycle of 30 per min. There is no limit on the length of wire that can be handled.

Perkins Machine & Gear Co, West Springfield, Mass

MORE DATA? Circle 82, inside back cover



Courtesy Combustion Engineering, Inc.

Combustion Engineering uses Gilberts for precision boring on atomic reactors

It takes an unusual boring mill (specifically, a Cincinnati Gilbert) to meet the specifications on this job:

(a) diameters within .001″,

(b) parallelism of center line of holes to center line of plate within .0001″ per inch,

(c) parallelism of flat surfaces within .010″,

(d) 32 R.M.S. surface finishes.

These are some of the machining requirements on this part for a fast breeder reactor built in the Chattanooga plant of Combustion Engineering, Inc., pioneer manufacturer in the nuclear field. They are typical of the quality of work assigned to this Cincinnati Gilbert table type horizontal boring mill. Automatic positioning makes work-handling fast and precise.

A number of other Gilbert boring mills are producing similar close-tolerance work for Combustion Engineering—proof that "those who buy Gilbert buy Gilbert again."

New Bulletin 1157 will show you why Gilbert boring mills do so many things so well.

The Cincinnati Gilbert Machine Tool Co., 3340 Beekman Street, Cincinnati 23, Ohio.

those who buy **GILBERT** *buy Gilbert again*

CIRCLE 274 READER SERVICE CARD

200-amp AC Welder Can Serve As Auxiliary Power Generator

Combination Weldanpower provides 115 or 230-v, 60-c ac single phase power. It is rated 5 kva, continuous duty, and will start and run motors up to 3 hp. Speed, when used as a power supply unit, is 1820 rpm. Unit supplies 20 to 200 amps of ac welding current for maintenance welding and hard-surfacing; it handles 5/64 through 3/16-in. electrodes. Engine speed, when set for welding, is 2100 rpm.

Separate windings for the welding and power circuits makes it possible to weld and supply power at the same time when necessary. Electrode and ground cables, head shield and lenses, electrode holder, and ground clamp are included in the price of the machine, approx $780.

Lincoln Electric Co, Cleveland 17, Ohio

MORE DATA? Circle 83, inside back cover

Extension Height Block Replaces Long Extension Arms

Device called Extension Height Block makes it possible to move inspection equipment closer to the workpiece, eliminating the need for excessive extension arm lengths. The block can easily be built up to any height requirement.

Block is a one-piece Meehanite casting. Standard over-all height is 10 in., plus or minus 0.0005 in. Clamping surfaces are provided for attaching measuring devices, and bottom-rear clamp space permits clamping the block in position for application of heavy equipment on the reach ledge. Sizes other than 10 in. are also available.

Machine Products Corp, 6771 McNichols Rd, Detroit 12, Mich

MORE DATA? Circle 84, inside back cover

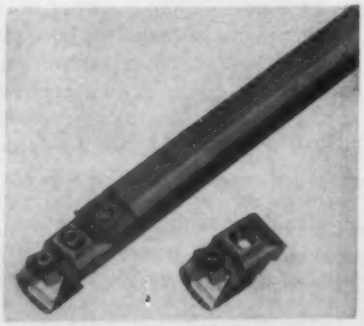
Precision Boring Spindles Feature Extreme Rigidity

Super precision line is introduced for operations using conventional boring tools, diamond boring tools, and similar tools.

Illustrated are No. 4308B block-type base; No. 4203B flanged base; and No. 4407B piggy-back assembly. These spindles, or the piggy-back assembly, are available in a standard design, or custom-built to suit individual requirements. They are permanently lubricated and dynamically balanced.

Standard Electrical Tool Co, 2480 W Sixth St, Cincinnati 4, Ohio

MORE DATA? Circle 85, inside back cover



Boring Bars Have Adjustable and Interchangeable Heads

Kennametal boring bars with adjustable and interchangeable heads are available in a complete line with either solid steel shank (Style BB-3000) or steel core encased in a Kennametal sleeve (Style BB-5000 K-Bars).

Bars are available in seven sizes ranging from 1 to 2½ in. dia. Two sizes of offset heads, each with diametral adjustment of ¼ in., are provided for the three smaller bar sizes, and three sizes of heads, each with an adjustment of ½ in., are provided for the four larger bar sizes. All heads accommodate Kendex throwaway triangular inserts and chipbreakers.

Kennametal Inc, Latrobe, Penna

MORE DATA? Circle 86, inside back cover

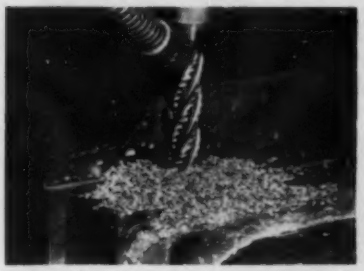
Portable Dust Collector Unit Designed for Wet or Dry Pick-Up

Self-contained Dust-Master Model 100 fits any 55-gal open-end steel drum and is said to have greater power and capacity.

Unit is cyclone separator type. Dust and chip-laden air is drawn directly into the drum through a double 90° inlet, causing the air to rotate around the inside of the drum. Heavy dust is precipitated to the bottom and out of the air stream by centrifugal action; very fine dust particles are discharged through the exhaust outlet into the after-filter bag, or may be piped outside the building. Large or heavy materials may be collected without damage to the unit. In addition to wet or dry pick-up, unit may be used for transferring liquids. It is equipped with a 1-hp suction blower and a 5-ft-long, 4-in.-dia suction hose. Price is $195 fob without steel drum.

Cincinnati Fan & Ventilator Co, 3548 Montgomery Rd, Cincinnati 7, Ohio

MORE DATA? Circle 87, inside back cover



Hob Ground Milling Cutters Take Deeper Cuts, Use Less Horsepower

Known as Hob Ground milling cutters, these cutters have been primarily designed for rough milling and have proved particularly effective in rough milling high tensile steels, especially in the extrusion die field.

The hob grinding process actually forms the cutting edge into a series of small, individual cutting edges. The cutters produce small or powdered chips, thus eliminating heating and clogging problems associated with rough milling. Deflection is practically eliminated regardless of flute length. The new tooth design permits deeper cuts and heavier feeds, while requiring only half the horsepower of regular cutters. In some cases it has been found possible to load these cutters, especially in long end milling, up to four times the normal load. Conventional regrinding techniques are used.

Multiple-flute end mills, 3-flute end mills, and tapered end mills are available from stock in a wide range of sizes. Prices range from $3.60 for a ¼-in.-dia mill with ⅝-in.-long flutes to $40.18 for a 2-in.-dia mill with 4-in. long flutes.

W C Chapman & Sons, Inc, 4705 Erdman Ave, Baltimore 5, Md

MORE DATA? Circle 88, inside back cover

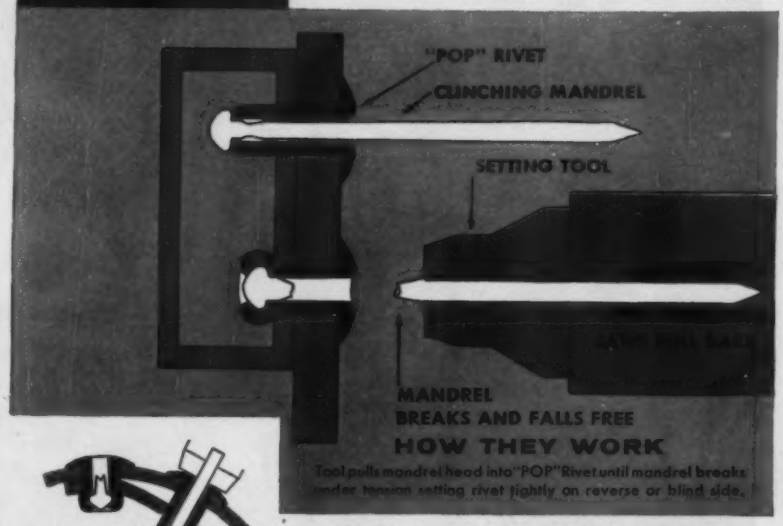
New Arcair Torch Offered For Light, Intermittent Jobs

Manually operated Model H-2, designed for small shop use, has positive air control valve in the torch

(continued on page 255)

5-Year Study Proves

Each "POP" RIVET Saves 4.9¢ on Installed Costs


"POP" RIVET
CLINCHING MANDREL
SETTING TOOL
MANDREL BREAKS AND FALLS FREE
HOW THEY WORK
Tool pulls mandrel head into "POP" Rivet until mandrel breaks under tension setting rivet tightly on reverse or blind side.

High Clinching Action
Pulls parts together with up to 600 lbs. squeeze. Eliminates need to clamp.

Wide Grip Range
Simplifies inventory, purchasing, inspection. Same length "POP" Rivet holds tight through thick or thin.

Vibration Proof
"POP" Rivets cannot back out or become loose. Ensures tight assembly for years of use.

Least Back-Up Space
Strong, high strength "POP" Rivets need only enough back-up space to provide room for set head. Gives more compact design.

Saves 4.9¢ each over other blind rivets

Saves 1.8¢ each over solid rivets

Replace 100,000 solid rivets with strong, high clinch "POP"® Rivets and you save $1,800. Use 100,000 time-tested "POP" Rivets for blind assembly work and you save $4,900.

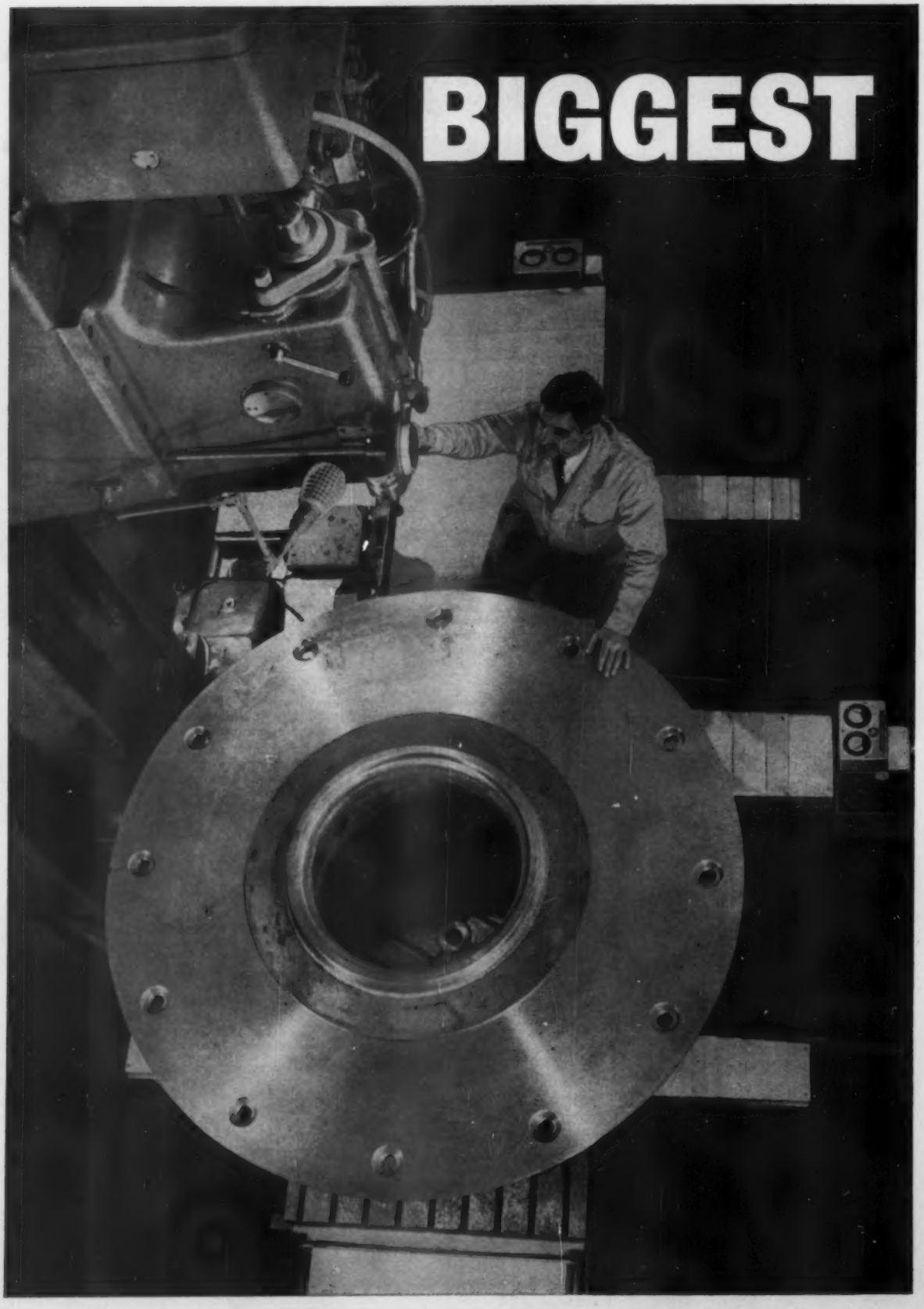
No other rivet equals the savings potential in *installed costs* provided by "POP" Rivets. The Martin Company saved $223,000 on one fifty-plane contract alone — and with today's rapidly increasing costs, even greater savings are possible. In addition, the extraordinary design flexibility of these rivets gives engineers many opportunities for simplified product design.

Extreme light weight, high production gun — only 2 lb., 3 oz. sharply reduces operator fatigue. Means more rivets set per hour right on the assembly line — rates as high as 1200 per hour even with unskilled operators.

Whether you make planes, missiles, cars, trucks, trailers, metal awnings, furniture, boats, or toys, you can cut costs, simplify design and add assembly convenience with "POP" Rivets. Call or write for our literature now — before you forget. Better still, send a sample assembly for riveting.

"POP"

"POP" RIVET DIVISION
UNITED SHOE MACHINERY CORPORATION
West Medway, Mass. • Phone: Keystone 3-6611

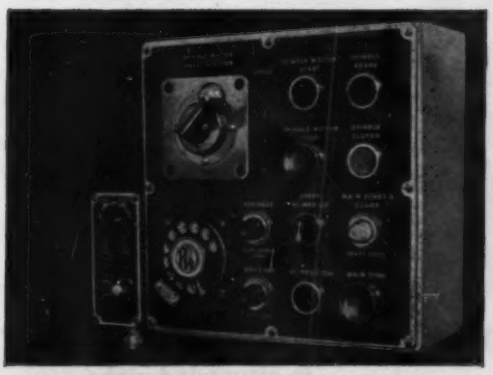

BIGGEST

Work-Size Capacity

. . . ever offered in a Precision Jig Borer!

the New PRATT & WHITNEY 4EA

with 70-inch height capacity from table to spindle end



NEW DIAL-TYPE CONTROL STATION

NEW INPUT DATA DISPLAY PANEL

This new P&W Jig Borer provides the extra capacity you need to handle large components. And – locating to *.0001"* – it has the dependable accuracy you need to meet the high standards of the aircraft, missile, nuclear energy and other industries where extreme precision is a must. Table-top-to-spindle-end maximum distance is 70", with a combined travel of head and quill of 64". As a result, the spindle can be brought within 6" of the table surface. It has the capacity to machine to the center of a workpiece 80" in diameter. Despite its greatly increased height, the 4EA Jig Borer has an accuracy of vertical alignment equal to that of all Pratt & Whitney Jig Borers. This is made possible, by an entirely new column design, with the counterbalances supported by an independent superstructure and not by the column itself.

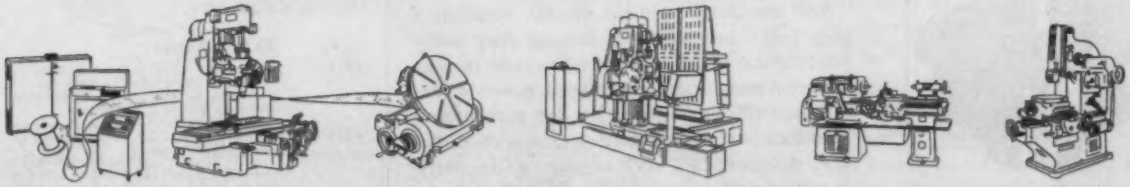
NEW DIAL-TYPE NUMERICAL CONTROL

To bring the greatest possible speed and efficiency to your high-precision jobs . . . and eliminate operator errors . . . the 4EA Jig Borer is equipped with P&W Numerical Control. This system provides for automatic positioning of the rectangular work table and, if desired, for the built-in rotary table as well.

Under P&W Numerical Control, the 4EA Jig Borer can be positioned automatically by a punched tape or – where tape control is not desired – the operator can feed positioning data into the machine using either of the 2 Control Stations. These compact stations feature a new control system that allows the operator to *dial* positioning data as quickly and easily as he dials a phone number. Since one of these stations is located at the front of the bed and the other on the spindle head, one will always be handy to the operator's hand. Operating under either tape or dial control, input data is always clearly indicated on a Display Panel located on top of the Tape Reader. This provides a continuous double-check on the correctness of positioning data.

If your jobs demand big capacity and extreme precision combined with peak production efficiency, the new Pratt & Whitney 4EA Jig Borer has everything you need to handle your work faster and more accurately. Write now for more complete information on the 4EA and on other P&W Precision Jig Borers.

PRATT & WHITNEY COMPANY, INC.
11 Charter Oak Blvd., West Hartford, Conn.

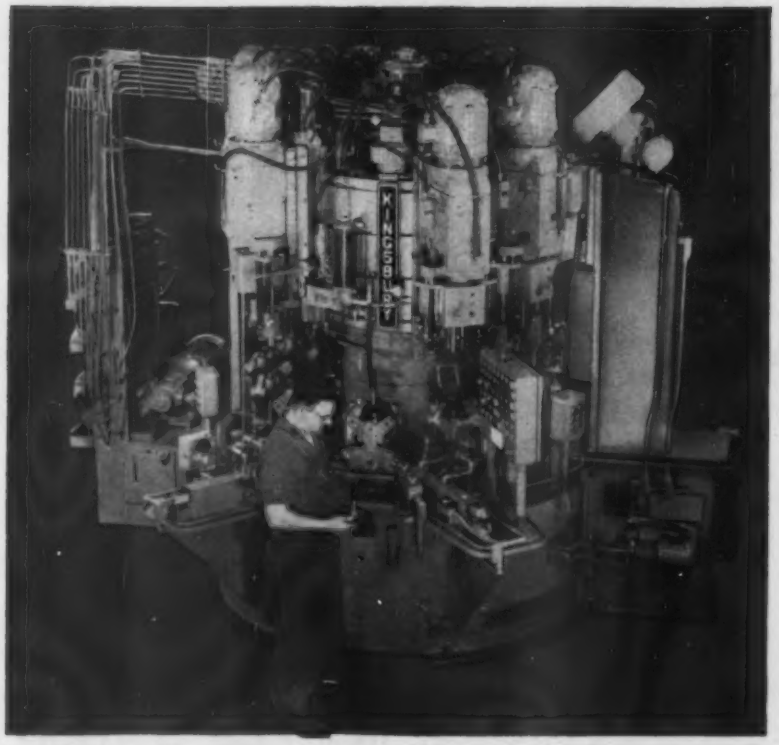


NUMERICAL CONTROL . . . JIG BORERS . . . ROTARY TABLES . . . KELLER MACHINES . . . LATHES . . . VERTICAL SHAPERS

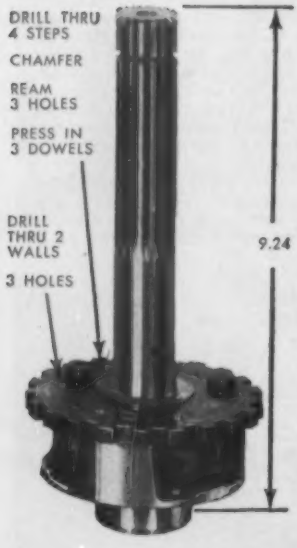
PRATT & WHITNEY

FIRST CHOICE FOR ACCURACY

MACHINE TOOLS • GAGES • CUTTING TOOLS



New 24-spindle Kingsbury has hydraulic slides, dowel presser



STEEL SHAFT ASSEMBLY FOR AUTOMATIC TRANSMISSION

At a gross rate of 210 parts an hour, eight vertical 3-spindle units on the center column operate on this shaft. To clear the stem of the work as it indexes, hydraulic slides raise these units 5.5 inches from their operating positions. The movement takes one second each way and has a smooth harmonic motion. Cams in the units feed the tools 2.7 to 3.5 inches more as required.

A dowel pressing unit is at the right. The operator loads dowels into the hopper at the top. Three dowels are fed down different tubes and are pressed into the work. At the previous station the work is washed clean of chips.

A 63-inch index table holds 12 work fixtures with power clamping and unclamping.

Real production without trouble. Production men praise our machines because they really produce and give little trouble. The main reasons are good basic design and rugged, accurate construction. If you have a job for a multi-unit automatic and can't afford to live with it day after day to make it work, consider a Kingsbury. It will pay off. Kingsbury Machine Tool Corp., Keene, New Hampshire.

KINGSBURY MULTI-UNIT AUTOMATICS

Kingsburys make money on simple jobs too

DRILL AND TAP 2 HOLES – 90° APART

PUMP PULLEY FOR AUTOMATIC WASHER

This simple machine makes money for the Maytag Co. by producing at a gross rate of 590 parts per hour with almost no downtime or rejects.

A 15-inch index table holds four work fixtures with manual clamping and unclamping. Four horizontal units drill and tap two holes. Bushings guide the drills for accuracy.

Typical Kingsbury jobs in eleven industries

These parts are used in a ball bearing, automatic transmission, door set, engine, generator, air conditioner, electric shaver, valve, aircraft engine, control instrument and rifle. All cost less on Kingsburys.

20 Distributors

EAST	Hartford 7	O C Stevens Mchy Co
	Long Island City 1	Triplex Mach Tool Co
	Philadelphia 6	John S Wright Mchy
	Syracuse 1, Buffalo 23, Rochester 4, Schenectady	Syracuse Supply Co
MIDWEST	Cincinnati 2	E A Kinsey Co
	Chicago 51, Milwaukee 8	Four States Mchy Co
	Cleveland 3, Toledo 13	Golden & McCoy
	Dayton 2	C H Gosiger Mchy Co
	Detroit 19	Birmingham & Conner Mchy
	Grand Rapids 4	Joseph Monahan Co
	Indianapolis 20	C C Garrett Mchy
	Pittsburgh 37	Merit Mchy Co
	St. Louis 24, Kansas City, Mo., Wichita, Tulsa	Robert R Stephens Mchy Co
SOUTH	Atlanta 6	J R Waltraven
	Charlotte 5	Geo A Marshall Mchy
WEST	Houston 13	Wessendorf Nelms & Co
	Denver 16	Mine & Smelter Supply Co
	Los Angeles 22, Berkeley 10, San Diego 3, San Jose, Scottsdale, Ariz.	Moore Mchy
	Spokane 8	W R Matthews Mchy & Tool Co
CANADA	Toronto 8	Barker Industrial Equip Ltd

handle. By holding the air orifice in the head of the torch within 4 in. of the work, unit can be operated on as low as 40 psi of compressed air. Model is priced at $49.50 .

Arcair Co, PO Box 431 Lancaster, Ohio

MORE DATA? Circle 89, inside back cover

Plastic hammers, tradenamed No-Mar, are available with "screw-in" replaceable tips. Tips are standardized in three grades: No. 1, a soft (red) plastic tip; No. 2, a hard (green) plastic tip; and No. 3, a very hard nylon (cream) tip. Hammers range from 5 oz to 2 lb.

Hunter Tool, Box 564, Whittier, Calif

MORE DATA? Circle 90, inside back cover

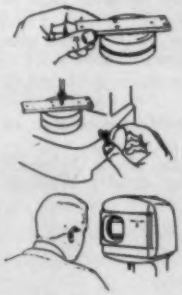
Dry tumbling creams, for use with wood pegs, sawdust or cobdust, are reported to provide clearer, brighter, and more scratch-free surfaces on metal and plastic products. The Mi-

New! BAUSCH & LOMB DR-25 OPTICAL GAGE

Direct scale reading to .0001" . . .

0" to 3" range . . . accurate to .000025"!

FAST, EASY AS A-B-C!



A Just set part to be measured on anvil . . . no masters or set gages needed. Large work table makes it easy to adapt special fixtures, accommodates widest variety of work.

B Turn knob to lower spindle . . . it will stop automatically on contact, with constant spindle pressure.

C See precise measurement at a glance . . . direct-reading scale is illuminated, magnified. No eyestrain, no conversion, no guesswork. Dependable measurement of depth, thickness, height, diameter, taper, angularity of surfaces, runout.

ONLY $695 COMPLETE

On-the-job demonstration! JUST MAIL THE COUPON TODAY!

Distributed in the U.S.A. through the DoALL Co.

BAUSCH & LOMB OPTICAL CO.
61835 St. Paul St., Rochester 2, N. Y.

☐ I'd like a free on-the-job demonstration of the new B&L DR-25 Optical Gage, with no obligation on my part.

☐ Please send Catalog D-285.

Name .....

Company ..... Title .....

Address .....

City ..... Zone ..... State .....

BAUSCH & LOMB
SINCE 1853

NEWS FROM WELLS MFG. CORP.
HORIZONTAL BAND SAW PIONEERS

A CONVERTIBLE BAND SAW

that will give you the capacity you've been looking for in a compact, modestly priced machine.

The new WELLS MODEL 58-B
Double Duty — Double Value Band Saw

• Here's the all new metal saw you have been asking for . . . Wells Model 58-B . . . designed and built to give you double duty—double value. It's a compact, rugged, well guarded, extremely versatile unit at an economical price.

As a horizontal cut-off saw, Model 58-B features quick action vise (swivels to 45 degrees), automatic shut-off and adjustable guides.

For vertical use, just swing head into upright position and install work table.

To give it complete mobility, a wheel-handle unit is available as optional equipment.

If you cut metal in the shop or on construction jobs, check the profit building advantages of Wells Model 58-B. Call your nearby Wellsaw Dealer or write for descriptive literature.

SPECIFICATIONS

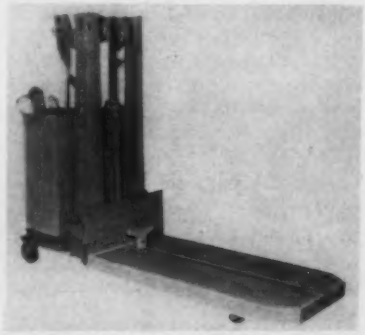
Capacity:	
Rectangular	6" x 10"
Round	6" Diameter
45° Angle	5" x 5"
Speeds, f.p.m.	76—141—268
Blade Size	½" x .025 x 93½"
Motor	½ H.P.
Width of Bed	8½"
Floor to top of Bed	22¼"
Floor Space	19" x 47"
Height (Frame Vertical)	52"
Height (Frame Horizontal)	37"
Vertical Capacity:	
Work Table	7⅝" x 10"
Throat Height	9½"
Throat Depth	7¾"
Net Weight (Approx.)	220 lbs.

The Pioneers of Horizontal
METAL CUTTING BAND SAWS
WELLS MANUFACTURING CORPORATION
505 Roosevelt Road Three Rivers, Michigan

crolyte finishing cream is used first; then the Hi-Glos cream is used to obtain a clear, high luster. Prices range from $7.55 per gallon in lots of 1 to 4 gallons to $6.45 per gallon in lots of 25 to 49 gallons.

H W Kramer Co, Inc, 120-30 Jamaica Ave, Richmond Hill 18, NY

MORE DATA? Circle 91, inside back cover



Battery-Powered Die Handler Added to Powrworker Line

High-lifting platform truck, the Powrworker Die handler, will lift stamping dies weighing up to 4000 lbs and tier them in storage. Dies are pulled on or pushed off the platform with a T-shaped hook driven by a hydraulically powered worm screw located under the platform. Platform is 26 in. wide and is available in lengths of 36 to 60 in. in 6-in. increments.

Unit will travel 2.3 mph loaded and has a lift speed of 12 fpm loaded. Either a single row or double row 12-v battery can be used. Without battery the truck weighs 2950 lbs.

Clark Equipment Co, Industrial Truck Div, Battle Creek, Mich

MORE DATA? Circle 92, inside back cover

Thread plug gage, tradenamed Black Diamond, features increased resistance to wear and abrasion which, under normal operation, provides two to five times longer life than standard steel gages. Prices are the same as for standard steel gages.

Threadwell Tap & Die Co, Greenfield, Mass

MORE DATA? Circle 93, inside back cover

Gear-type fluid motors, designated 4MO Series, are rated from 90 to 210 in.-lb torque per 100 psi, for operating pressures to 1000 psi. They are available in both flange and foot

(continued on page 260)

Mr. E. M. Goddard reports that Hazel Bishop, Inc. uses Scott Wipers around filling lines, bottle labelers, stapling machines . . . and in the removal of reject labels, lipstick smudges from cases, and condensation from lipstick molds. Employees get boxes of fresh Scott Wipers, keep them right at their work stations.

People buy Scott Wipers for many reasons:

Hazel Bishop cut wiping costs 15% by switching to versatile, disposable Scott Wipers!

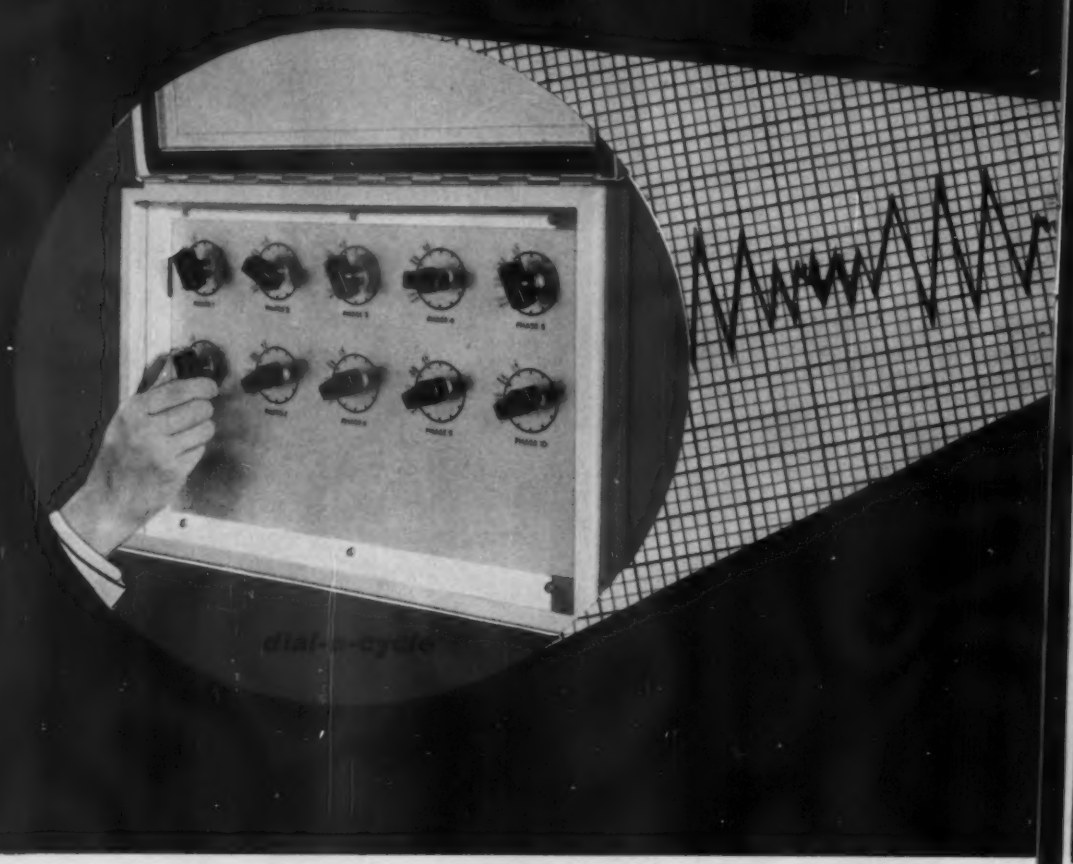
Hazel Bishop, Inc., Paramus, New Jersey, has used Scott Wipers for two years. Says Mr. E. M. Goddard, Plant Manager and Purchasing Agent: "We first installed Scott Wipers to give employees a strong, disposable wiper that leaves no lint on filling lines and lipstick assembly lines. Now we use them for machine wiping and many other jobs—and have cut wiping costs at least 15% by switching to Scott Wipers." Advantages: less pilferage, no laundry expenses, simplified in-plant distribution, daily disposal of used Scott Wipers. Mr. Goddard adds that Scott Wipers are soft, easy to use, and are credited with maintaining strict sanitation in the handling of "Hazel Bishop Lasting Nail Polish" and "New Formula Hazel Bishop Long-Lasting Lipstick."

SCOTT PAPER

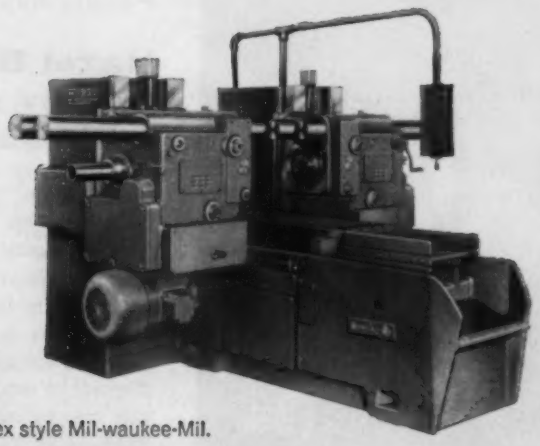
Get the full story from your Scott distributor on Hazel Bishop and many other satisfied users of Scott Wipers. Look in the Yellow Pages under "Paper Towels" or write: Scott Paper Company, Dept. AM-811, Chester, Pa.

Maker of the famous Scott paper products you use in your home.
See "Father Knows Best" on CBS-TV.

CIRCLE 281 READER SERVICE CARD



*first **dial** your results from the blueprint . . .*



Kearney & Trecker Duplex style Mil-waukee-Mil.

Designers and Builders of Precision and Production Machine Tools Since 1898

KEARNEY & TRECKER MILWAUKEE ®

CIRCLE 282 READER SERVICE CARD

then get programmed production ***automatically***
with the NEW ***Kearney & Trecker***

Mil-waukee-Mil® BED TYPE
PRODUCTION MILLING MACHINE

- ***dial-a-cycle*** **panel programs and controls each and every machine function . . . automatically!**
- **Interrupt or resume cycles at any time without returning to "start" position!**
- **Change from *dial-a-cycle* automatic control to manual with the flip of a switch!**
- **Choose from 72 standard models . . . Simplex and Duplex . . . 7½ to 30 hp.**

Fast, pre-phased setups slash idle cutter time — dramatically boost finished workpiece production. Do it on this remarkable new Kearney & Trecker Mil-waukee-Mil programmed production milling machine.

Operator simply dial-programs machine function into the ***dial-a-cycle*** control panel. No guesswork! He merely reads workpiece blueprint and establishes machining sequence with successive phase-switch dials.

Free Bulletin MM-58—

Kearney & Trecker Corp., 6786 West National Ave., Milwaukee 14, Wisconsin.

CIRCLE 283 READER SERVICE CARD

HOW B. Jahn

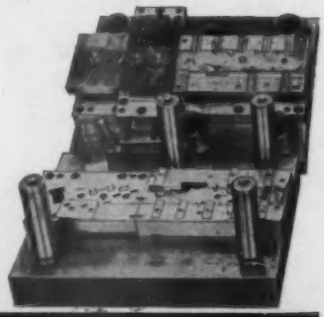
PROGRESSIVE DIES INSURE

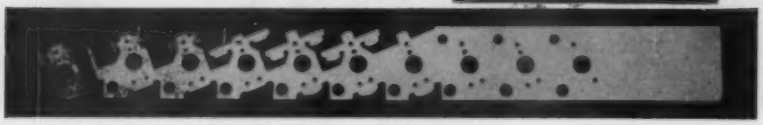
MASS PRODUCTION PRECISION & PROFITS

3 Cylinder Lock Parts Produced with Speed and Economy!

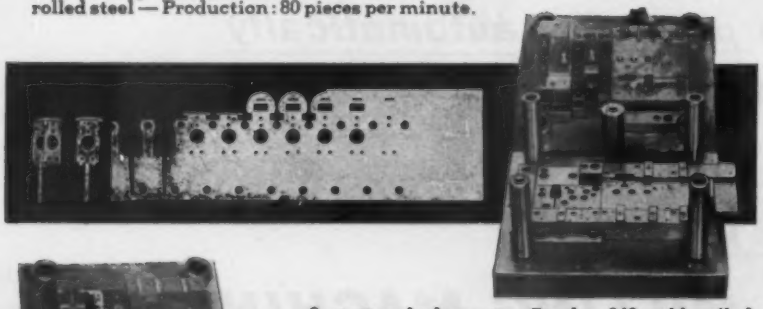
The ingenuity and precision designed into these B. Jahn Progressive Dies pays off in speed, economy and precision for millions of mass produced components.

In addition to eliminating many costly production operations, the parts produced make up interchangeable precision cylinder lock assemblies, mass produced for maximum service with economy. B. Jahn Dies may be the Key to your product profit problems.

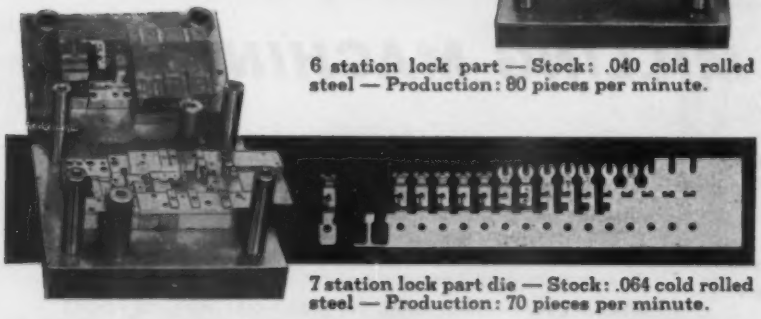




8 station progressive die — Stock: .040 cold rolled steel — Production: 80 pieces per minute.



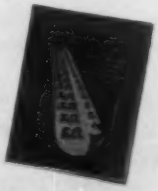
6 station lock part — Stock: .040 cold rolled steel — Production: 80 pieces per minute.



7 station lock part die — Stock: .064 cold rolled steel — Production: 70 pieces per minute.

B. Jahn

Send for B. Jahn Brochure Today—



THE B. JAHN MANUFACTURING COMPANY, NEW BRITAIN, CONNECTICUT

mountings, with ports designed for SAE split-flange connections. Performance curves and installation data available.

New York Air Brake Co, Hydreco Div, Kalamazoo, Mich

MORE DATA? Circle 94, inside back cover

Industrial cutting knives, tradenamed Safety-Guard, are constructed of heavy-duty machined aluminum and have a knurled, easy-to-grip sliding sleeve which may be locked at any position on the knife barrel. Sleeve can be positioned to expose only as much of the blade as is necessary. The sleeve also acts as a depth gage. A twist of the locking collar loosens or grips the blade.

X-acto, Inc, 48-41 Van Dam St, Long Island City 1, NY

MORE DATA? Circle 95, inside back cover

Hydraulic pump motors, in heavy-duty frame sizes, 364U and 365U, have been added to company's line of spline-coupled hydraulic pump mount motors. These latest additions extend the line to cover sizes from ½ through 50 hp. No mechanical couplings are needed; alignment is automatic. Motors are supplied for either single or double end pump installations.

Reuland Electric Co, Alhambra, Calif

MORE DATA? Circle 96, inside back cover

Roller bearings for milling machine outboard supports are reported to provide production increases of 40% and cutter life increases of 350%. Bearings are readily installed with

"Where were you when I was turning out good ones?"

no machine rework and no bearing adjustments are required. Each bearing is supplied with two extra sets of bushings which permits use with three sizes of arbors.

Sonnet Tool & Mfg Co, 580 N Prairie Ave, Hawthorne, Calif

MORE DATA? Circle 97, inside back cover

Plastic Steel additive, known as Devcon Flex, mixes with company's Plastic Steel to produce a part that will stand up to sledge-hammer pounding without breaking. The mixture is said to provide the strength of metal combined with the flexibility of rubber. Many applications are seen in the forming die field and in repair of metal parts. Pint, quart, and gallon sizes available.

Devcon Corp, Danvers, Mass

MORE DATA? Circle 98, inside back cover

Variable-speed pulleys provide constant speed regardless of wide variations in load. A cam automatically maintains required belt tension for any given speed. Known as the Hi-Lo FHP line, pulleys are available in ratings of ½, ¾, or 1 hp at 1750 rpm. The ½-hp unit is available with either high-impact plastic or cast iron face; other sizes are cast iron. Speed ratios vary from 2:1 for the ½- and ¾-hp models to 2½:1 for the 1-hp model.

Lovejoy Flexible Coupling Co, 4866H West Lake St, Chicago 44, Ill

MORE DATA? Circle 99, inside back cover

Impact wrench chuck converts an impact wrench into a heavy-duty drill. Chuck fits all ½-in. square drive tool and holds ⅛-in. to ½-in. drills. It features a keyless gripping action and is rugged enough to withstand the shock created by impact power tools.

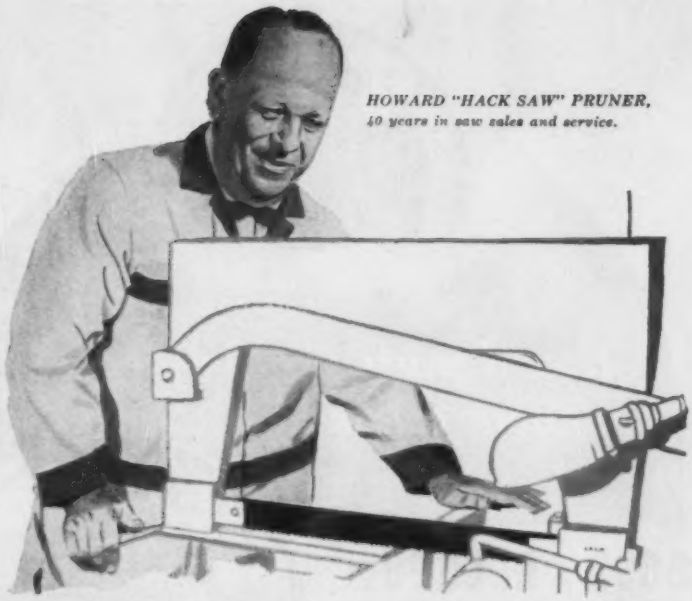
Supreme Products Corp, 2222 S Calumet Ave, Chicago 16, Ill

MORE DATA? Circle 100, inside back cover

High-speed-steel rods, hardened and centerless ground to a tolerance of 0.0002 in., are available in a range of sizes from 3/64 through ¼ in. in 36-in. lengths. Rod is said to be ideal for making punches, dies, gages, pins, dowels, collets, tools and many other steel parts.

Lavallee & Ide, Chicopee, Mass

MORE DATA? Circle 101, inside back cover



HOWARD "HACK SAW" PRUNER, 40 years in saw sales and service.

PRODUCTION SPEED AND ACCURATE CUTTING WITH

LENOX POWER HACK SAW BLADES

You can count on increased production with LENOX power blades featuring long-wearing teeth and straight cutting performance. LENOX power blades are heat treated and toughened under modern electronic controls to guarantee strong, uniform hardness. For a better blade . . . better made . . . you can always depend on LENOX.

OPERATIONAL STUDY? An experienced, technically-trained Lenox factory engineer is available to analyze your power hack saw operation . . . and possibly show you how to save time and money. Write or call today for immediate service. No obligation, of course.

HACKMASTER TYPE *High speed welded edge, shatterproof.*

MO-SPEED TYPE *High speed steel, all-hard.*

INDUSTRIAL DISTRIBUTORS THE RIGHT HAND OF PRODUCTION

LENOX
THE TOOLS [illegible] ID BOX

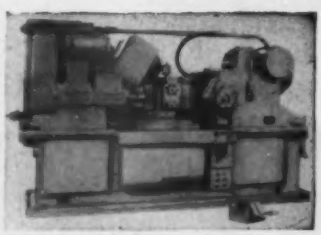
AMERICAN SAW & MFG. COMPANY
SPRINGFIELD, MASSACHUSETTS • U.S.A.

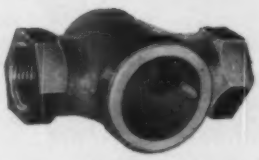
...and parts are finished without rehandling on

GOSS & DeLEEUW AUTOMATIC CHUCKING MACHINES

The Goss & DeLeeuw "One-Two-Three" Chucker differs from the conventional machine in that it provides the means of machining more than one end of a piece in a single handling instead of requiring several handlings and set-ups. A worthwhile gain in production time is assured.

In the "1-2-3", work is gripped in chuck and all ends machined either in sequence or simultaneously. Goss & DeLeeuw and only Goss & DeLeeuw offers this feature in a standard chucking machine.





A few typical parts finished on this machine are shown here. Write for detailed description . . . send samples of your work for time and cost estimates.

GOSS & DeLEEUW
PRODUCT QUALITY

GOSS and DE LEEUW
MACHINE COMPANY, KENSINGTON, CONN., U.S.A.

Magnifying Comparator Checks Small Parts, Threads, Gages

Known as the Finescale Magnifying Comparator, this small instrument can be fitted with a series of interchangeable reticles for checking and measuring radii, angles, chamfers, threads, small holes, lineal, radial and tangent dimensions, and odd shapes. It can also be used for checking gages, templets, layouts, forms and sizes of punches, dies, etc.

Certified accurate scales are photographically transferred onto low-expansion film. This film is used for the interchangeable reticles. Reticles are supplied in pairs, one having black lines and one white lines, to insure contrast with the work being measured.

Two models are available, a pocket model and a desk model. The desk model, complete with four sets of reticles and a case, sells for $18.50. A wide variety of additional reticles are available at a cost of $1 per pair.

Finescale Co, 218 S Western Ave, Los Angeles 4, Calif

MORE DATA? Circle 102, inside back cover

New Electronic Plater Added to Ramyr Line

Unit is designed specifically for precision plating of precious metals on electronic components. Features include a Sangamo ampere-hour meter, available in various sizes to

TON FOR TON . . . DOLLAR FOR DOLLAR

FEATURING NIAGARA'S FAMED MULTI-POINT MECHANICAL SLEEVE CLUTCH

Picks up load on 14 engaging jaws. Applies driving force concentrically without keys or pins. Assures instant engagement and maximum productive strokes per minute. Needs no air nor electricity. Practically no maintenance. Greater safety: Simplified controls, fewer parts to wear out. *Yes, it permits, inching, too.*

1¼ - 6⅛ inch shaft diameters

5½ - 150 ton capacities

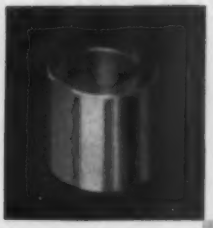
Here's a workhorse that's known for setting the pace on the most demanding jobs... jobs where the clutch is engaged and disengaged at every press stroke... jobs that call for operation three shifts a day, day in and day out.

Built and *backed* by a company which produces industry's greatest variety of inclinables*, Series A Presses have amassed an unusual success record in thousands of applications. To be specific, let's take a close look at a Series A user:

28 OBI'S SINGLE STROKED 707,140,000 TIMES
WITHOUT ONE CENT SPENT ON CLUTCH ENGAGING SURFACES

GET THE FULL REPORT

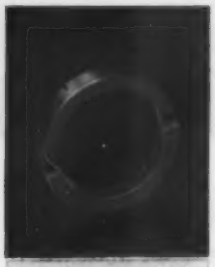
NIAGARA



THE

simplest answer

TO BEARING PROBLEMS



Bunting capability and leadership in the field of Cast Bronze Bearings and parts are well established and widely recognized. Today Bunting offers an equally comprehensive and responsible service in the field of Sintered Powdered Metal Bearings and parts.

Bunting's special knowledge and facilities make Sintered Powdered Metal products available in many applications not heretofore considered feasible. We can help you find the simplest answer to your individual problem, be it Cast Bronze or Sintered Metal.

A wide range of stock sizes of Bunting Cast Bronze and Sintered Powdered Bronze self-lubricating, plain and flange bearings, thrust bearings and bars are available from Bunting distributors everywhere in America.

Write for catalogs and your copy of the new 24 page Bunting Engineering handbook of Sintered Powdered products and their composition, manufacture and application.

Bunting.

BUSHINGS, BEARINGS, BARS AND SPECIAL PARTS OF CAST BRONZE AND POWDERED METAL

The Bunting Brass and Bronze Company • Toledo 1, Ohio • Branches in Principal Cities

NEW SHOP EQUIPMENT

accurately measure deposition of metal and to determine amount of metallic content to be replaced; a 0 to 1-amp meter with 20-ma graduations that assure accurate reading for plating of minute parts (separate fuse on the meter protects against overloads); automatic timer regulates plating interval, includes a switch to by-pass timer unit when longer plating cycle is desired.

Over-all size is 14¼ in. high by 14½ in. deep by 21½ in. wide. Input current is 115 v, single phase, 60 c; filtered dc output, 0-8 v, 10 amps with less than 1% ripple.

Ramyr Mfg Co, 1779 N Main St, Los Angeles 31, Calif

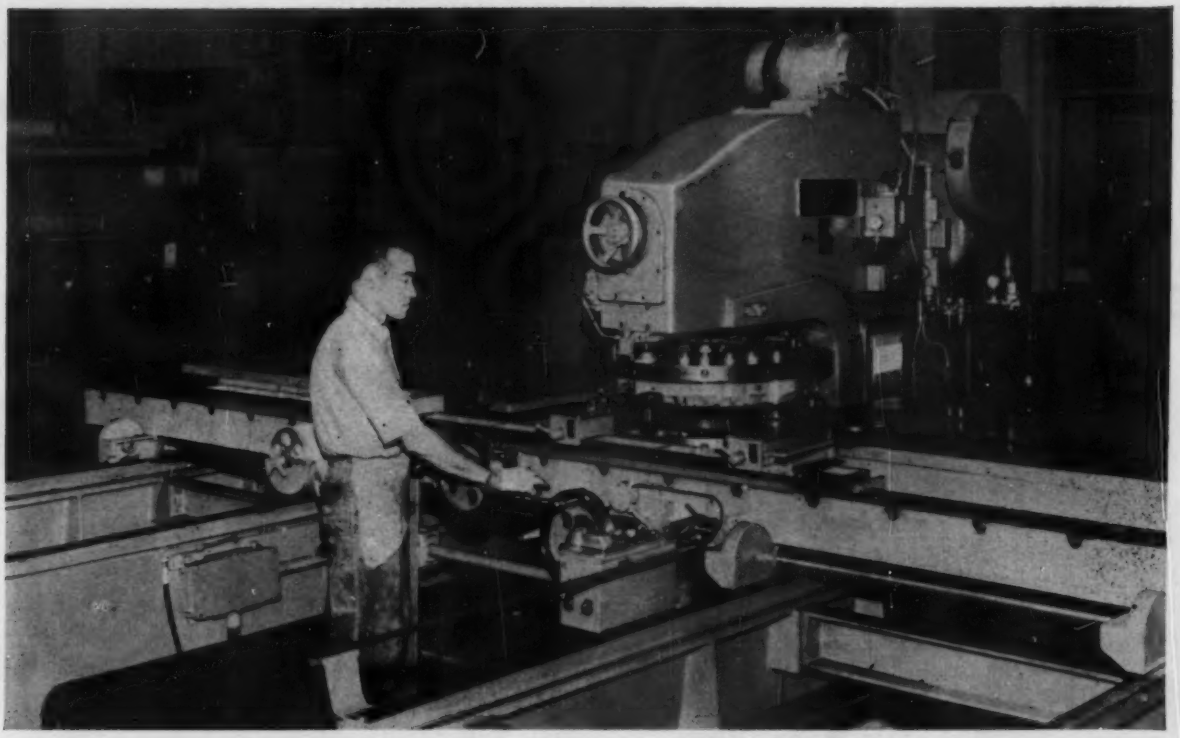
MORE DATA? Circle 103, inside back cover

Socket hole cleaners are used to clean dirt and foreign matter from machine tool spindle sockets. Tough, wear-resistant polyethylene blades assure long life and maximum protection for the sockets being cleaned. Tapered models are available for Morse taper holes 1 through 6, for Nos. 30, 40 and 50 NMTBA taper holes, for Nos. 6, 7 and 10 Jarno taper holes, as well as for Nos. 7, 9, 10, 11 and 12 B&S taper holes. Tools for cleaning straight holes are available in diameters of ⅝ through 1⅞ in.

Scully-Jones and Co, 1901 S Rockwell St, Chicago 8, Ill

MORE DATA? Circle 104, inside back cover

"I know this is called the age of automation, Bob, but stop referring to our plant as prehistoric!"



One WIEDEMANN *Saves Over* $27,000 *a Year for* Reliance Electric

. . . and equally startling savings of from 60% to 90% are reported by users of Wiedemann Turret Punch Presses throughout industry.

With the Wiedemann Method, parts are completely pierced as needed—costly inventory is reduced. Layout, nibbling, drilling and other hand operations are eliminated. Engineering time is minimized, and changes can be made at low cost.

If you are producing openings of any size or shape in sheet metal or plate, it will pay you to get the facts about the Wiedemann Method.

Send for the full story on how this Wiedemann paid for itself in less than two years at Reliance Electric, and a copy of Bulletin 301.

Here's what Reliance Electric & Engineering Co., Cleveland saves on producing control panels for electronic and magnetic systems:

57% in direct labor on "Control Panel" production.

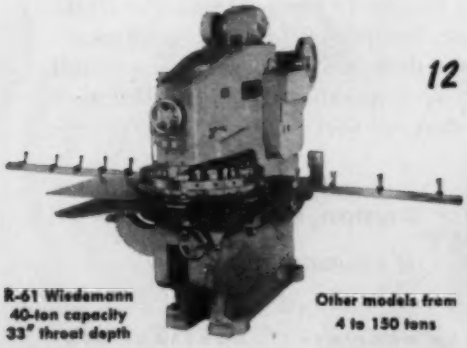
78% in direct labor on "Operator Panel" production.

26% in cost of parts previously purchased.

1008 hours per year of engineering time spent specifying and modifying stock panels.

276 hours a year in recording inventories and added rate setting.

SIMILAR SAVINGS CAN BE YOURS



R-61 Wiedemann 40-ton capacity 33" throat depth

Other models from 4 to 150 tons

12 to 32 Punches and Dies Ready for Use

WIEDEMANN
MACHINE COMPANY
TURRET PUNCH PRESSES

DEPT. AM-11 • GULPH ROAD • KING OF PRUSSIA, PA.

"I get 1200 parts a minute from each of these presses...

...all day long!" And production like that continues day in, day out. For Bliss High Production presses are especially designed for continuous high speed operation. Counterbalanced shaft, massive tie rod frame... square gibbing...features like these add up to *enduring* speed. For ease of operation there's ample room in front and back for die setting and space *under* the press for tote boxes or stacking chutes. Naturally, if you use large quantities of stampings this is the press that makes them. You will, however, be surprised to learn, that H-P presses can be set up so quickly and efficiently that more and more firms are using them for short run work.

BLISS
SINCE 1857

E. W. BLISS COMPANY · Canton, Ohio

BLISS is more than a name... it's a guarantee

PRESSES • ROLLING MILLS • ROLLS • DIE SETS • CAN MACHINERY • CONTRACT MFG.

CIRCLE 290 READER SERVICE CARD

NEW SHOP EQUIPMENT

Mechanics' tool chests, made of heavy-gage steel, feature many combinations of chests and roller cabinets plus the company's Theft-proof one-piece locking system.

Hunter Tool, Box 564, Whittier, Calif

MORE DATA? Circle 105, inside back cover

Hole center finder provides fast, accurate spotting of hole centers. In one simple operation the tool transfers the location of a hole, establishes the center point of the hole, and marks the point for easy drill location. Tool can be used on metal, plastic, wood or any other material. It comes in kit form, consisting of one center punch and eight sleeve plugs. Sizes range from 5/16 to ¾ in.

James Products Co, 801 Mentor Ave, Mentor, Ohio

MORE DATA? Circle 106, inside back cover

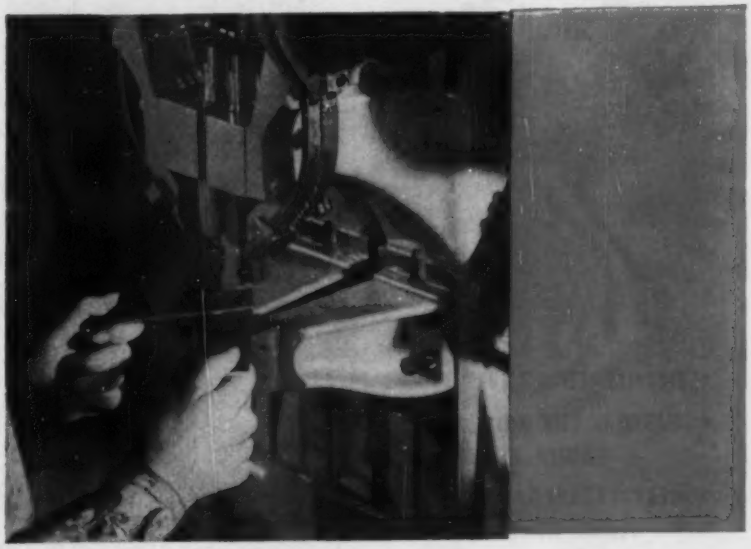
Cup-type safety goggles, available in eight new models, are injection molded from tough thermo-plastic, have high impact resistance, and are designed for heavy industrial applications. Two models have replaceable soft sponge face pad. Four chipper-type goggles have heat-treated Bal-Safe lenses and perforated side shields. Welding goggles feature Arc-Ban, a dark green glass that provides protection from infrared and UV rays.

Bausch & Lomb Optical Co, Rochester 2, NY

MORE DATA? Circle 107, inside back cover

"Then how about some stainless steel pot and pan scrubbers for Mrs Frothingham!"

CUT UNIT ASSEMBLY COSTS . . .
GET HIGH-SPEED, LOW-COST FASTENING . . .
TAKE ADVANTAGE OF AUTOMATIC ASSEMBLY

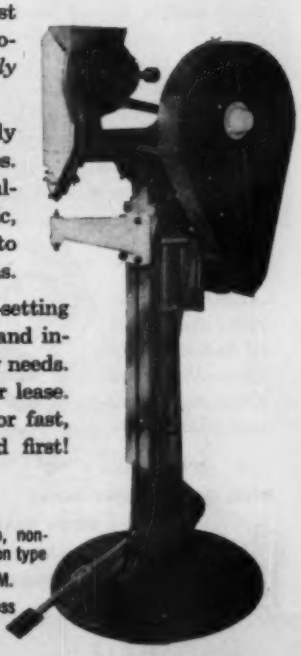


Milford shows you how to cut assembly costs!

Tubular rivets are basically a low-cost fastener. Feed and clinch them with automatic Milford Riveters, and you *multiply* the cost savings inherent in rivets.

The Milford Riveter shown here is only one of a full line of automatic machines. Bench or floor models . . . single or multiple spindle . . . manual or automatic, the Milford Riveter line is designed to solve your toughest assembly problems.

Remember . . . these are *basic* rivet-setting machines. They can be tooled quickly and inexpensively for your particular assembly needs. And it's up to you whether you buy or lease. For a complete line of fasteners . . . for fast, trouble-free assembly—look to Milford first!



MODEL 220-BH

RIVET CAPACITY: 1/32" dia. by 1/8" length to 9/64" dia. by 1/4" length.
THROAT DEPTH: 11"
POST HEIGHT: From 0" to 18"
HOPPER: Rotary
CLUTCH: Single trip, non-repeating Horton type
FLYWHEEL: 260 R.P.M.
DRIVE: V-belt noiseless

MODEL 220 BH

THE MILFORD RIVET & MACHINE CO.
MILFORD, CONNECTICUT • HATBORO, PENNSYLVANIA
ELYRIA, OHIO • AURORA, ILLINOIS • NORWALK, CALIF.

CIRCLE 291 READER SERVICE CARD

Large or small INDUSTRIAL CUT GEARS

- FURNISHED COMPLETE
- CUSTOM CUT FROM YOUR BLANKS
- HEAT-TREATED, CASE OR FLAME-HARDENED

SIMONDS GEAR produces a complete line of industrial cut gears in a full range of sizes from cast or forged steel, gray iron, bronze, Meehanite, rawhide or bakelite. Also heat-treated, case or flame-hardened carbon or alloy steel. Or, you may have your own gear blanks custom cut to your order. Same quality . . . same prompt service. Send us your requirements for quotation.

ALSO stock carrying distributors of Ramsey Silent Chain Drives and Couplings; and industrial V-belts.

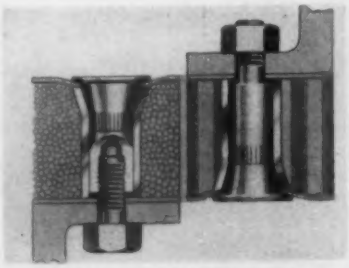
SPUR GEARS • BEVEL GEARS • MITRE GEARS WORMS • WORM GEARS RACKS PINIONS

SIMONDS GEARS

THE SIMONDS GEAR & MFG. CO.

LIBERTY at 25TH PITTSBURGH 22, PA.

Quality Gears for Over 65 Years



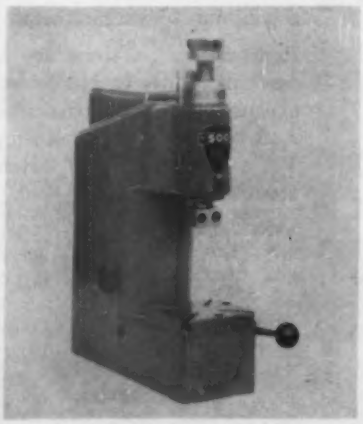
New Delron Structural Fastener Introduced for Sandwich Panels

New unit designed to provide additional strength for a variety of sandwich panels consists of two pre-assembled parts: body and expanding sleeve. Body section is available in many forms including internal threaded, threaded stud, male rivet, and through-bolt types. Flush applications with minimum dimple are assured on both skins through die action of body and sleeve. In use, the unit is retained in panel by a splined interlock which also prevents rotation. If threaded body is damaged in handling of panel, it is easily replaced.

High column strength prevents crushing of panels, and max shear strength is guaranteed by distribution of loads to both skins. Model is available in a variety of styles, sizes, and materials including aluminum, carbon and stainless steels.

Delron Co, 5224 Southern Ave, South Gate, Calif

MORE DATA? Circle 108, inside back cover



Small Pneumatic Presses Have Micrometer Depth Stop

Designed for all types of production and assembly operations, these two presses, the PH 2 with a 500-lb ca-

STERLING "G-2" with 25° Tilting Spindle for FAST, ACCURATE Tool and Cutter Grinding

STERLING "G-2" UNIVERSAL Available in PLAIN Model also

Compare Construction . . . Capacity . . . Features . . . Cost!

The STERLING 25° Tilting Spindle takes guess work out of setting clearance angles, makes set-up changes simpler and insures accurate grinding. Extra capacity and versatility make the STERLING "G-2" an outstanding Tool & Cutter Grinder. Available in Plain and Universal Models.

Sharpen Drills 1/8" to 2 1/2", 90° to 140° included angle, on ONE Drill Grinder

The STERLING "DV" grinds drill lips equally, with accurate, pre-determined clearance angle and included angle. True conical grind produces free cutting drill that drills more accurate holes per sharpening.

For complete information see your McDONOUGH Dealer or write direct for Bulletin DV-1.

McDONOUGH MANUFACTURING CO.

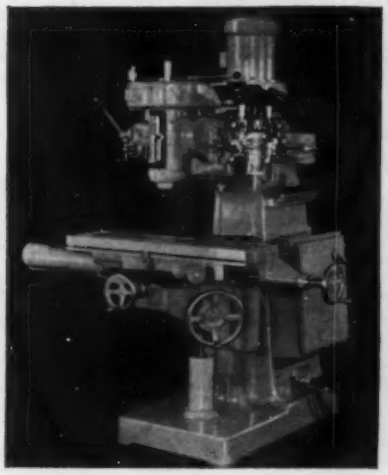
1526 GALLOWAY • EAU CLAIRE, WISC

INCREDIBLE? NO!

THESE SAVINGS ARE REAL

GORTON MACHINE TOOLS,

both standard and custom-designed, are today *paying for themselves in record time. Here are just three typical examples:



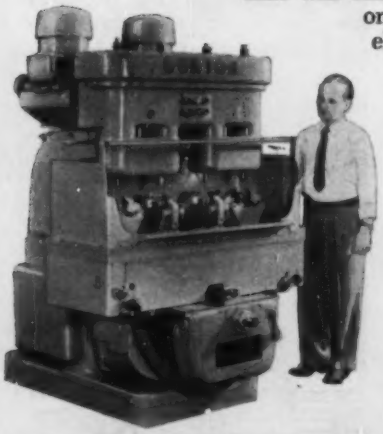
from 8 Hours per piece to 5 Minutes per piece

This standard Gorton Trace-Master Hydraulic Duplicator was purchased to profile a complex part from a simple master. Previous cost of this operation was $102.40. Present cost with this Gorton machine is $1.07. Saving per piece is $101.33.

*Cost figures were arrived at by using $2.80 per hour for operator's time and $10.00 per hour, Machine rate.

cost saving per piece . . . $1,139.20

This Gorton Horizontal Mill with special holding fixture, tooling, hydraulics, etc., was purchased to machine thirty-five impeller blades from the solid, involving compound curvatures, thicknesses and depths. Former production time was one piece in 100 hours. Present time on this new machine is one piece in eleven hours. Machine was paid for after machining 22 pieces.



$50,000 machine pays for itself in 41 Weeks

This Gorton 4-spindle "Automatic Cycle" Duplicator was purchased to mill out recesses in a round steel part. Original production time on a manually operated single spindle duplicator was 60 pieces per hour. Present production on this new machine is 204 pieces per hour. Cost saving is 71%.

Cost reduction and improved accuracy are important to you today. We shall be glad to analyze your needs and make specific recommendations on request.

Your letterhead inquiry will receive prompt attention.

GORTON

GEORGE GORTON MACHINE CO.

1511 Racine Street • Racine, Wisconsin

SINCE 1893

Tracer-Controlled Pantographs, Duplicators — standard and special . . . Horizontal and Vertical Mills, Swiss-Type Screw Machines, Tool Grinders, Small Tools and Accessories.

A8-1012

Illustration shows the 110, 150 and 200-Ton Capacity Oliver-Farquhar O.B.I. Mechanical Gap Presses. Also available in a 75-Ton capacity model.

...fast, smooth, quiet for efficient trimming, blanking, drawing

The clean, symmetrical lines of Oliver-Farquhar O.B.I. Mechanical Gap Presses picture a design that's new from the ground up. Construction is solid. Dependable alignment is assured. Slides and dies "float" to reduce operational shock. The low inertia clutch permits higher cycling, cooler operation, low maintenance. Rugged heavy duty adjusting screw—fully guided—barrel type—arranged for easy floor level adjustment. Slide is of flanged type construction. Four (4) extra long adjustable guides, one on each corner, assure stability of alignment.

Oliver-Farquhar O.B.I. Mechanical Gap Presses provide unobstructed access to the die area from three sides. Safety controls included at no extra cost.

These new presses are available in four models: 75, 110, 150 and 200-Ton capacities.

We invite you to write, wire or phone for complete information on the whisper quiet, smooth running, fast setting Oliver-Farquhar O.B.I. Mechanical Gap Presses—available now for delivery.

A. B. FARQUHAR DIVISION
The Oliver Corporation
Press and Special Machinery Departments
York 11, Pennsylvania

OLIVER Farquhar PRESSES

Also Manufacturers of Farquhar Conveyors

pacity and the PH 3 with a 1700-lb capacity, operate on 85-psi air line pressure.

Length of stroke is adjustable from 0.004 to 1.18 in. A micrometer depth stop with an accuracy of 0.0001 in. is built into the presses. Ram speed is also adjustable.

The heavier model, the PH 3, allows independent settings for separate downward and upward speeds. Both machines have T-slotted bases. Applied pressure can be reduced by lowering the air line pressure.

Imported by the American LIP Corp, Room 704, 610 Fifth Ave, New York 20, NY

MORE DATA? Circle 109, inside back cover

Gearshift drives are available in a wide range of styles and gear ratios for vertical mounting. Units are used with geared devices or V-belts and sheaves to step-up or reduce the output speeds on drilling and tapping machines, materials handling equipment, etc. Horsepower ratings range from ½ to 10 hp.

Lima Electric Motor Co, Inc, Lima, Ohio

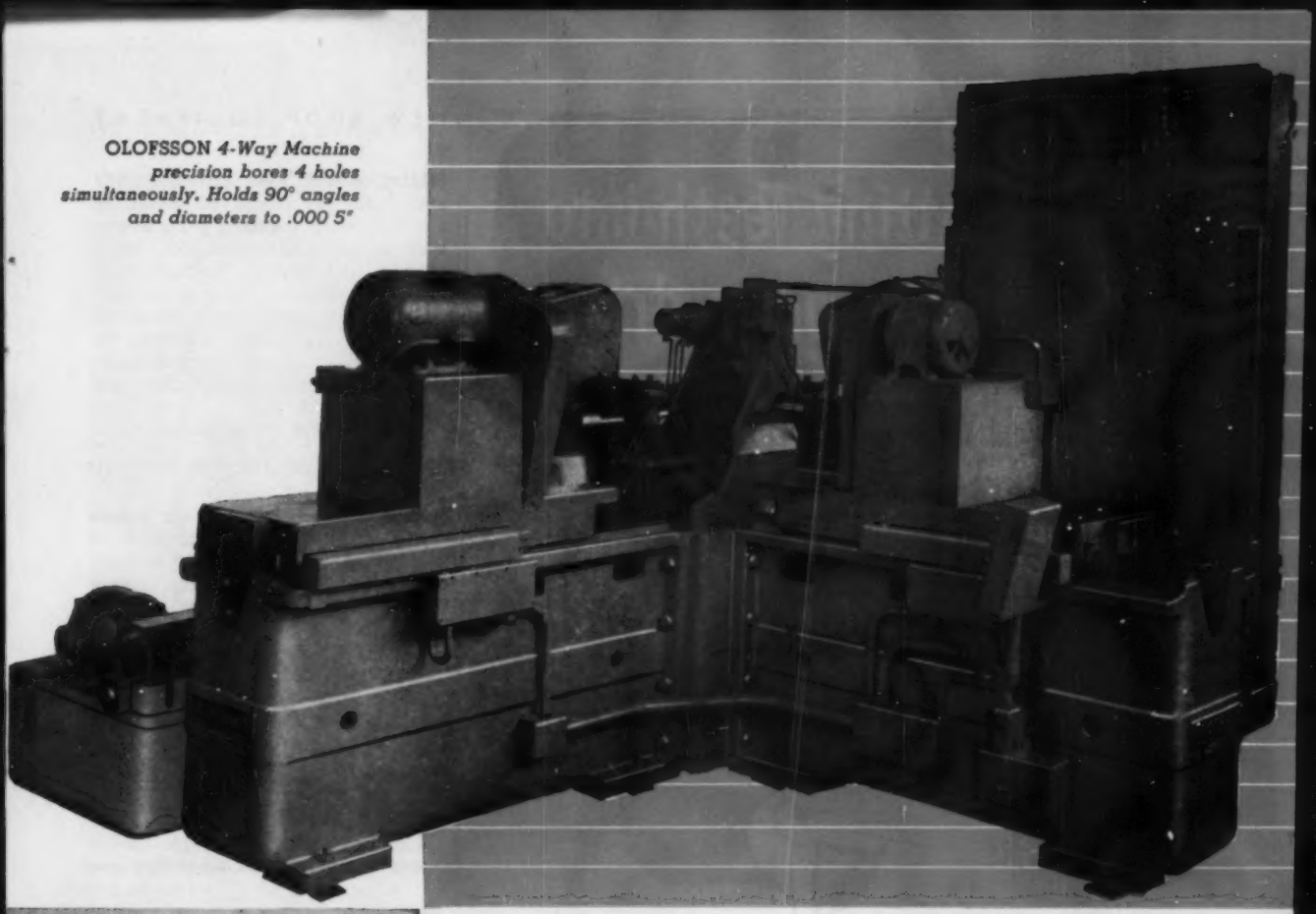
MORE DATA? Circle 110, inside back cover

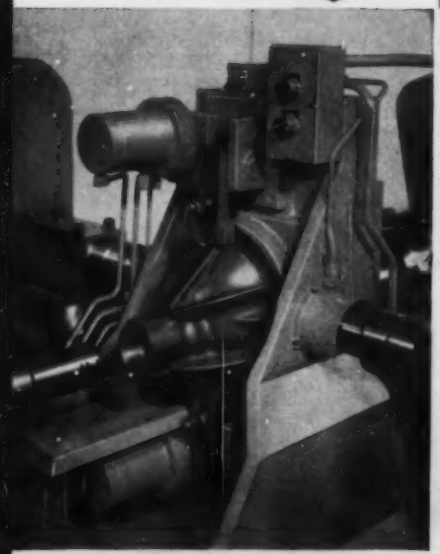
Welding cable reel is self-retracting and designed to hold 50 ft of 2/0 cable. It has a current capacity of 300 amps with 60% overload factor. Reel, designated Weldreel Model EA2, is easily mounted on wall, floor, ceiling, or mobile equipment.

United Specialties, Inc, El Dorado, Ark

MORE DATA? Circle 111, inside back cover

OLOFSSON *4-Way Machine precision bores 4 holes simultaneously. Holds 90° angles and diameters to .000 5"*





Close-up view of differential carrier, hydraulically cam-clamped in position for boring.

for MORE production and precision, combine 2, 3, or 4 OLOFSSON way units in any COMBINATION

OLOFSSON Precision Way Machines perform fast, accurate boring, facing, turning, grooving, and chamfering. Units are electrically interlocked, and the spindles move to the work.

For long, dependable, and accurate operation Olofsson Way Units feature:

- **Single push-button control panel.**
- **Hardened and ground V-style ways.**
- **Hydraulic control Valves, manifold mounted and located with reservoir.**
- **Parker Majestic precision boring spindle.**
- **Rigid ribbed, nickle iron base.**
- **Adherence to latest J.I.C. recommendations.**
- **Hydraulic pump units located outside base.**
- **Automatic central lubrication system.**
- **Dwell time not affected by positive stop screw adjustment.**

FOR COMPLETE INFORMATION WRITE OLOFSSON CORPORATION OR PHONE LANSING, MICHIGAN, IVANHOE 4-5381.

THE OLOFSSON CORPORATION
2728 Lyons Ave., Lansing, Michigan

MANUFACTURERS OF PRECISION BORING MACHINES AND SPECIAL MACHINERY

CIRCLE 296 READER SERVICE CARD

We mean *real* teeth – the kind you must have for quiet, smooth operation.

Teeth that are accurate in lead, profile and finish. Teeth that make your gears do the job they are designed to do.

We know gears! And we have the latest equipment to make, inspect and *guarantee* custom gears – of all types.

Shaving capacity to 39".
Tooth Grinding to 25".
Involute charts furnished.

Let us quote on your requirements for custom gears and custom gear boxes.

CINTI® **GEARS,** good gears only

THE CINCINNATI GEAR CO.

Wooster Pike and Mariemont Ave. Cincinnati 27, Ohio

Custom Gear Makers Since 1907

NEW SHOP EQUIPMENT

Sliding motor base provides easy and rapid movement of motor in systems using variable pitch drives that require provision for more take-up than normal V-drives. Two sizes are available. One is for motors with NEMA frame numbers from 182 through 284U, and sells for $33.25; the other is for frame numbers from 286U through 365, and sells for $36.25.

Browning Mfg Co, Maysville, Ky

MORE DATA? Circle 112, inside back cover

Mechanical booster vacuum pumps operate at faster pumping speeds in the pressure range from 10 microns to 1 millimeter than comparable units. The first four models in the series, Models 1710, 1711, 1712, and 1713, have max pumping speeds of 1050, 1250, 2900, and 5100 cfm respectively and an ultimate vacuum of ½ micron. Larger units, with capacities up to 10,000 cfm, are under development.

F J Stokes Corp, Vacuum Equipment Div, 5500 Tabor Rd, Philadelphia 20, Penna

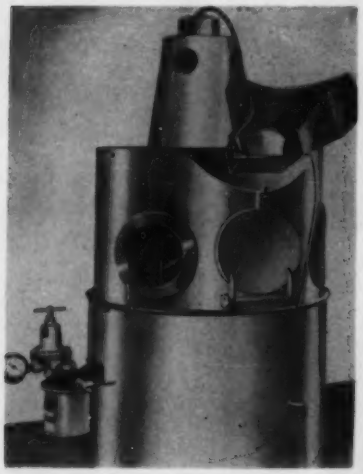
MORE DATA? Circle 113, inside back cover

Comparator head, Model No. AE-22 is designed for use with the company's Porta-Check, a portable transistorized comparator. Head has a measuring range of 0.006 in. on the thousandths scale and 0.0006 in. on the "tenths" scale. When used with the Porta-Check, this head reads to 0.00001 in.

B C Ames Co, Waltham, Mass

MORE DATA? Circle 114, inside back cover

"It's your turn to listen to him brag about winning the shop pool . . . keep him here till I get away. . ."



Wet Blast Honer Handles Cutting Tools and Drills

The Liqui-Breez is designed for honing all types of tungsten-carbide and HSS cutting tools and drills. Operation of the machine requires an abrasive load of 5 lbs plus 3 lbs of water. Applications include high quality finish deburring of small machined parts.

Unit has a self-contained bench cabinet 36 in. high, 18 in. dia, with a working chamber 13 in. high, 18 in. dia, and loading door 5¾ in. dia. It is furnished with factory installed rubber gauntlets, is pedal-operated, and has a specially designed viewing scope and shield to permit direct view of the work.

Tobin-Arp Mfg Co, 6400 Penn Ave South, Minneapolis 23, Minn

MORE DATA, Circle 115, inside back cover

Permanent magnetic chuck, latest and largest in the company's line, is 12 x 24 in. This No. 1224 has all the features of the earlier models (*AM*—Sep 9 '57, p186) and is entirely suitable for milling and planing.

O S Walker Co, Inc, Worcester, Mass

MORE DATA? Circle 116, inside back cover

Control valve, Model C, is designed for responsive control and is especially suited to handling abrasive and corrosive slurries. A cast steel housing jackets a 1-in.-thick gum rubber or Neoprene sleeve liner. Valve is available in 1½, 2, 3, and 4-in. sizes.

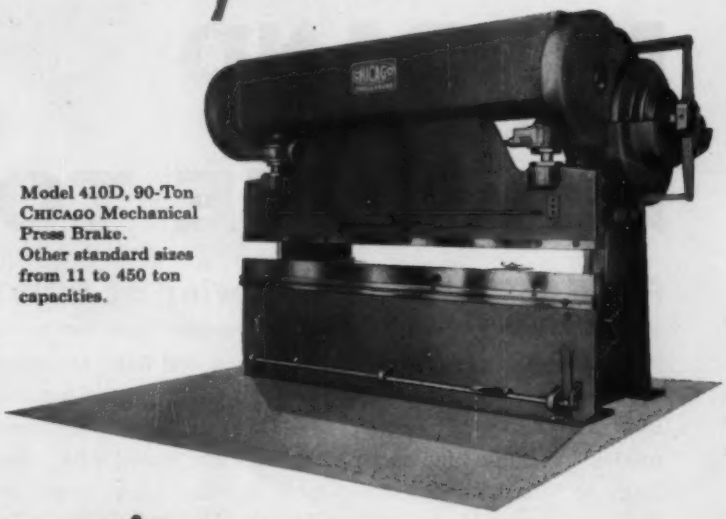
Clarkson Co, 564 Market St, San Francisco 4, Calif

MORE DATA? Circle 117, inside back cover

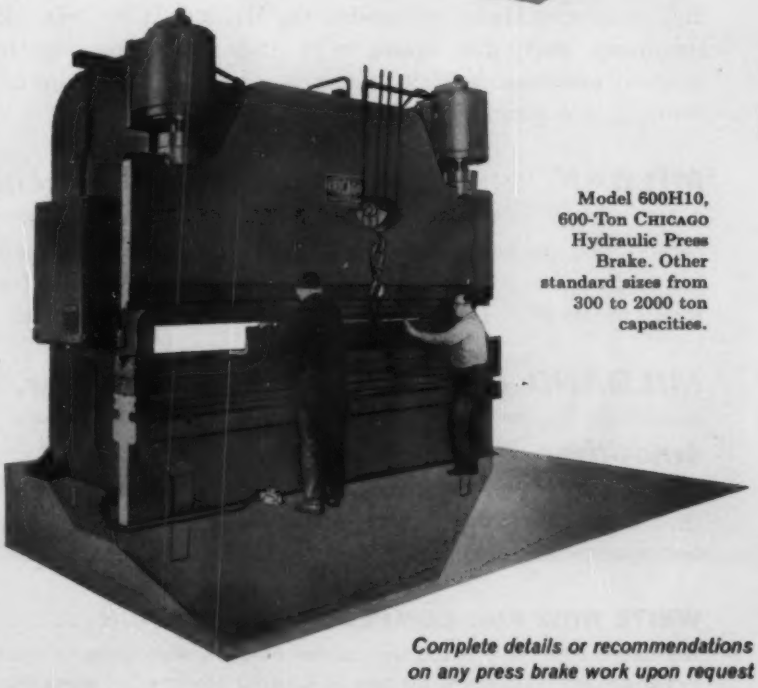
(Continued on page 276)

CHICAGO® PRESS BRAKES

unexcelled accuracy / ***for sheet metal and plate work***



Model 410D, 90-Ton CHICAGO Mechanical Press Brake. Other standard sizes from 11 to 450 ton capacities.



Model 600H10, 600-Ton CHICAGO Hydraulic Press Brake. Other standard sizes from 300 to 2000 ton capacities.

Complete details or recommendations on any press brake work upon request

8439

Press Brakes
Press Brake Dies
Straight-Side-Type Presses
Hand and Power Bending Brakes
Special Forming Machines

CHICAGO DREIS & KRUMP

DREIS & KRUMP MANUFACTURING CO.
7434 S. Loomis Blvd., Chicago 36, Illinois

CIRCLE 298 READER SERVICE CARD

NEW

MILBAND
BAND SAW
MACHINE TOOL

For FASTER Cut-off Sawing at LOWER COST!

The all-new MILFORD MILBAND is the *first* band saw machine specifically designed, developed and constructed from the bottom up to give you the extra ruggedness, rigidity, variable speed range and other characteristics needed to handle high speed steel band saw blades with maximum efficiency. Built to withstand the heavy feeds and fast blade speeds of which high speed steel blades are capable, the MILBAND Machine takes continuous, heavy duty sawing in its stride without requiring frequent or costly maintenance. Here, in fact, is the machine you need to produce more . . . save more!

MILBAND gives you lowest cost-per-cut . . .

because you get more pieces per man-machine hour. Fully automatic bar feed permits a completely automatic stock feeding cycle. Narrower kerf with at least 50% less chip loss means big savings in material.

MILBAND cuts consistently straighter, smoother, more accurately . . .

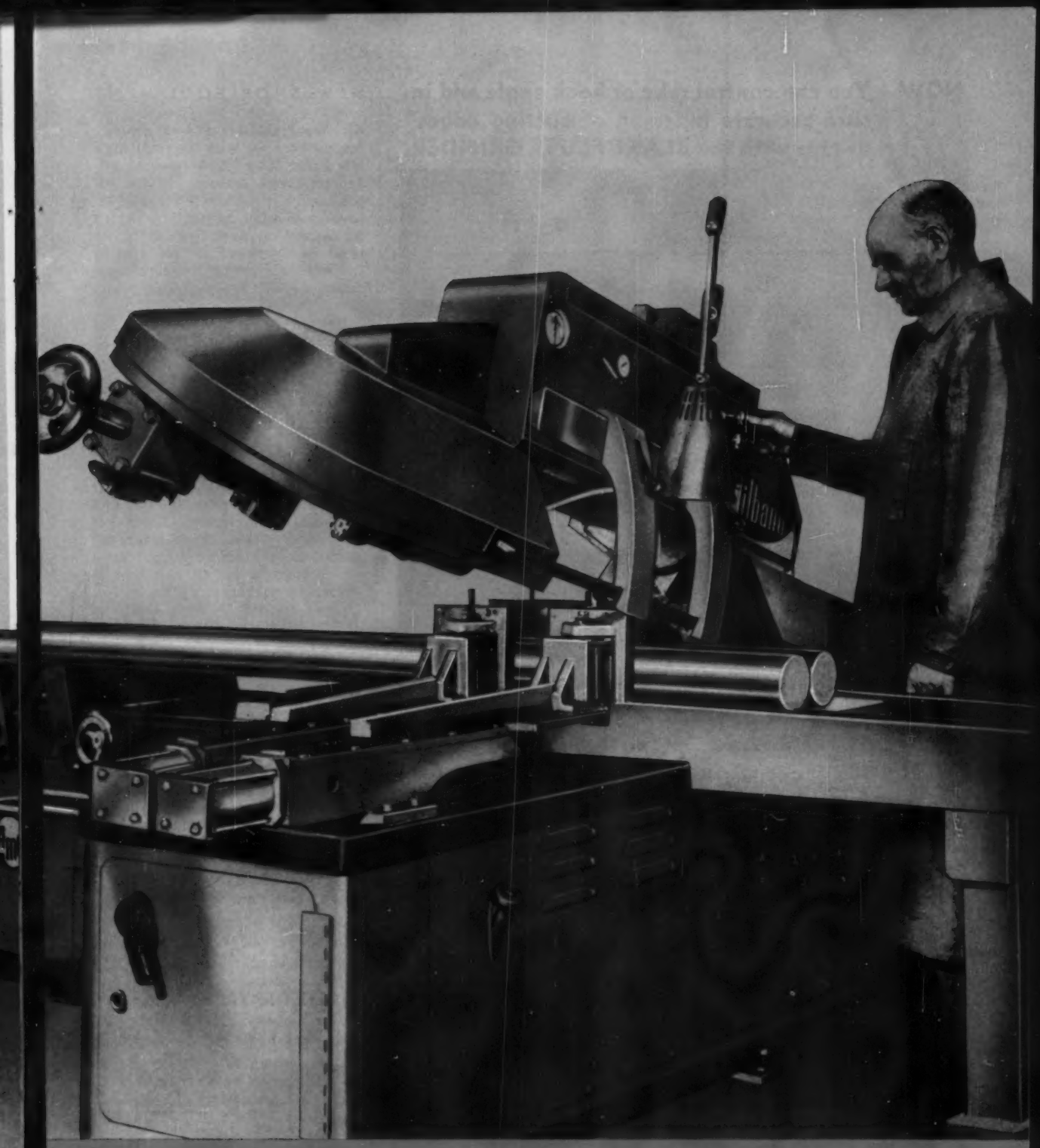
than other cut-off methods. This means less allowance for waste, less subsequent machining time to remove surplus metal.

WRITE NOW FOR COMPLETE INFORMATION . . .

Ask for your free copy of this circular that fully describes all the time- and money-saving advantages of the new MILBAND Machine . . . shows how this machine will help you reduce per-cut costs and cut metal faster and more efficiently than ever before. Remember, the sooner you put a MILBAND to work in your shop, the more you'll save . . . so act today!

The Henry G. Thompson & Son Co., 271 Chapel Street
New Haven 5, Connecticut.

CIRCLE 299 READER SERVICE CARD



MILFORD

HACK • BAND • SAW • BLADES • HOLE SAWS • GROUND FLAT STOCK

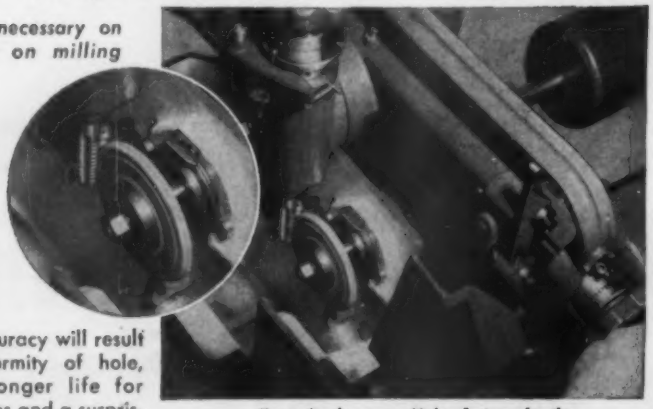
THE HENRY G. THOMPSON & SON CO., New Haven 5, Connecticut

Saw Blade Specialists for Over 80 Years

CIRCLE 300 READER SERVICE CARD

NOW – You can control rake or hook angle and insure accurate indexing of cutting edges* of taps with the BLAKE FLUTE GRINDER.

**Just as necessary on taps as on milling cutters.*



This accuracy will result in uniformity of hole, much longer life for your taps and a surprising savings in tap costs.

Keep it sharp — Make 1 tap do the work of 6 with The Blake Flute Grinder.

Write for bulletins on BLAKE Tap Sharpening Machines

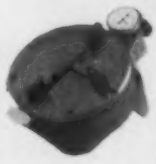
EDWARD **BLAKE** COMPANY INC.
MANUFACTURERS OF FLUTE AND CHAMFER GRINDERS
435 CHERRY ST., WEST NEWTON 65, MASS.

Exclusive Distributors of:
Black Diamond Drill Grinders • Surface Finish Standards • Worcester Drill Grinders

CIRCLE 301 READER SERVICE CARD

ACRA-MENT

The Measure of Quality



BENCH COMPARATORS
Compact, high-fidelity gages with capacity to 7" I.D. and O.D. Sensitive contact jaw retracts for easy positioning of work piece. Choice of "T" or "Y" plate.

SNAP GAGES
Rugged, multi-purpose snap gages; nine different models covering a range ⅛"—14". Narrow frame (¼") models available for close work. Also single purpose gages for large runs at minimum cost.

ACRA-MENT

COMBINATION I.D.-O.D. GAGES
Eight models covering a range from 1¾" I.D. — ⅜" O.D. to 54" I.D. and O.D. Larger sizes to order. Modifications to suit specific requirements available in all gages shown.

Send for new bulletin information

ACRA-MENT INSTRUMENT DIVISION
SEALOL CORP.
2011 Post Road • Providence 5, R. I.

NEW SHOP EQUIPMENT

Air line regulators and lubricators, designed for use with the company's Mead Jet filter, have several advanced design features. In the lubricator, it is the acceleration of air passing through a venturi which forms the oil mist, instead of air pressure. Oversized air passages in the regulator permit pressure regulation without any material reduction in flow.

Mead Specialties Co, Dept R-4, 4114 N Knox Ave, Chicago 41, Ill

MORE DATA? Circle 118, inside back cover

Optical flats are available in either clear fused quartz or Pyrex glass. They are supplied in two certified accuracies, 1/10 or 1/5 light band, to cover a wide range of flatness readings. Both types are double surfaced to avoid reading errors. Known as Lapmaster Optical Flats, they are furnished in standard sizes from 1 in. through 12 in. dia and are individually packaged.

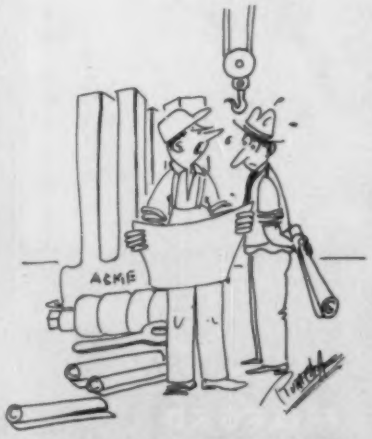
Crane Packing Co, Dept AMN, 6400 Oakton St, Morton Grove, Ill

MORE DATA? Circle 119, inside back cover

Digital torque indicator, Model DTI-2, uses a precision servo null-balance system of measurement to provide a continuous digital presentation of torque values, in in.-lb or ft-lb. Used with an auxiliary slidewire, the unit can provide direct horsepower readings. Indicator operates on 115-v, 60-c alternating current.

Performance Measurements Co, 15301 W McNichols, Detroit 35, Mich

MORE DATA? Circle 120, inside back cover



"Which print do we use today . . . they keep changing these parts so fast . . . I haven't had a chance to get started. . ."

Vinson Steel and Aluminum Co.
Dallas, Texas says:

Shearing capacity of this machine is 12'-0" x ½" mild steel. Note accessibility of two cranks on right end housing. Upper crank is for knife adjustment. Lower one is for back gauge adjustment.

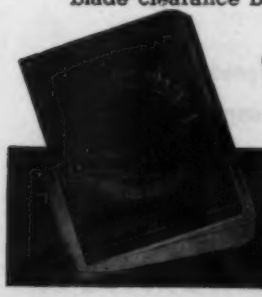
Adjustable Blade Clearance Allows Use of Shear for Complete Range of Thicknesses

THE feature that Vinson Steel and Aluminum Company likes best on their Steelweld Shear is the adjustable blade clearance. This permits them to use the one machine for their complete range of thicknesses. They go as low as 26 gauge galvanized material and up to ½ inch mild steel and ½ inch aluminum.

As a leading supplier of metal in North and West Texas, Vinson insists on cuts being sharp, straight and accurate. This requires that the blade clearance be correct for every thickness cut. Because of the unique easy method of adjusting the clearance on Steelweld Shears, the adjustment can be made in seconds.

Another item which is impressive is the low maintenance cost. This machine has been in service for over two years, and the maintenance has been practically nil.

More and more warehouses are installing Steelweld Shears. Usually one will handle a range of work that would require two or more other type machines not built with a fast knife adjustment feature.



GET THIS BOOK!

CATALOG No. 2011 gives construction and engineering details. Profusely illustrated.

THE CLEVELAND CRANE & ENGINEERING CO.
1452 EAST 282nd STREET, WICKLIFFE, OHIO

STEELWELD PIVOTED BLADE SHEARS

CONTROL
the finish
...and the
COSTS
with the

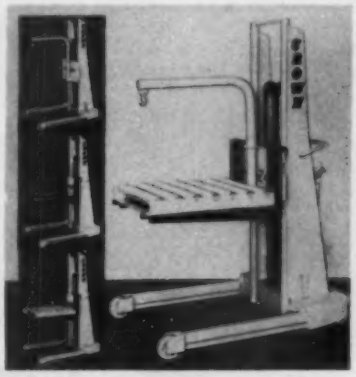
No over-finishing . . . no under-finishing with the Brush Surfindicator. Weighing only 15 lbs. and ready to be plugged into any 115 volt outlet, it provides on-the-job instant surface measurement. Controlled finish is now practical—inexpensive—and extremely profitable.

The Brush Surfindicator measures any surface—any shape—any size. Accurate measurements in microinches can be seen at a glance! It brings you laboratory-precision measurement unaffected by magnetic fields, vibration or line voltage variation. It requires no skill . . . can be used by anyone who can read a meter. Measurements are easily made

surfindicator

in complete compliance with the new ASA and military standards. Write for the ASA standards and all of the complete facts on this profit-making tool that will pay for itself!

brush INSTRUMENTS
DIVISION OF
3405 PERKINS AVENUE CLEVITE CORPORATION CLEVELAND 14, OHIO



Portable Lift Performs Variety Of Lifting Operations

Model L-642 can be fitted with a variety of attachments that permit it to do all kinds of lifting jobs. Each lift is shipped complete with the following accessories: roller top table, smooth plate platform, adjustable forks, and a demountable boom.

Lifting capacity is rated at 2000 lb at a 15-in. load center on the roller top, smooth plate and forks. The boom is rated at 500 lb at a 15-in. load center.

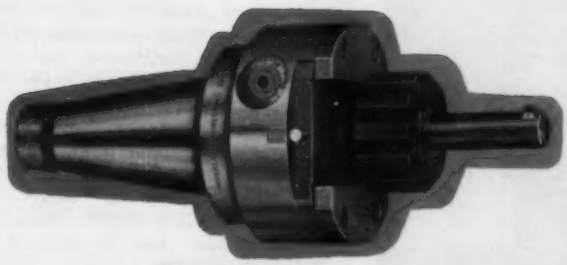
Lift is manually operated. Hydraulic oil is pumped into a lifting cylinder under pressure to raise loads a total of 60 in. Lowered height is 8 in.

Crown Controls Co Inc, New Bremen, Ohio

MORE DATA? Circle 121, inside back cover

Newly Designed Vise Adjusts To Wide Range of Shapes

All-Shapes vise has a pair of pivoted members, mounted on a heavy swivel turret, that replace the usual sliding front jaw. Combination of swivel and pivoting action allows the two portions of the front jaw to equalize



UNIVERSAL BORING CHUCK is heavy and rigid for all types of rough boring without chatter yet accuracy of adjustment adapts it equally well to finish boring. Time-tested Universal Collet nose holds boring tool much more rigidly and securely than set screws while precision and extreme accuracy of feed-adjustment are obtained by an anti-backlash arrangement of feed screw and large dial.

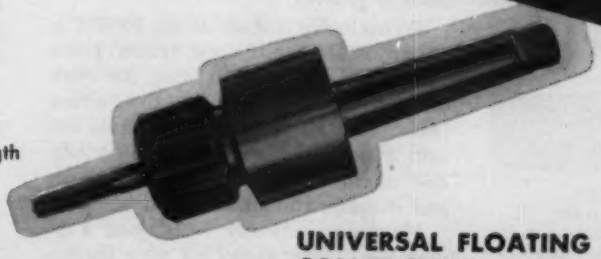
UNIVERSAL RELEASING TAP CHUCK has same basic collet principle featured in all Universal Collet Chucks. Screws or sleeves are not needed and collets are interchangeable with other Universal chucks. Simple, compact design has no springs, cams or pawls to break or wear. Can be used for either right or left hand tapping without adjustment.

HIGH PRESSURE REVOLVING COOLANT TRANSFER CHUCK has standard Universal Collet Chuck nose and a variety of shank sizes can be held by simply changing collets. Minimum overhang is made possible by the single face seal design. Back pressure principle of this design prevents "brake" action thus lowering torque on spindles. Chucks for higher speed and pressures than standard plus a variety of mountings are also available.

UNIVERSAL
COLLET CHUCKS

combine maximum holding power and minimum run out with simplicity of design and low price

The basic collet principle is the same in all Universal chucks. Tools gripped in these chucks withstand a maximum thrust and radial load because the collet grips on a continuous surface its full length and positively locks the tool. Write today for new catalog showing the complete line of Universal collets and chucks.



UNIVERSAL FLOATING COLLET CHUCK for horizontal or vertical operation is positively protected against destructive action of coolant by a seal which prevents entrance of compounds into interior of assembly. Frictionless ball bearing flat springs are adjustable to counter-balance weight of the tool.

210

UNIVERSAL ENGINEERING COMPANY FRANKENMUTH 1, MICHIGAN

CIRCLE 305 READER SERVICE CARD 279

and adjust automatically to practically any shape. Because multipoint contact distributes jaw pressures widely and evenly, even thin-walled shapes or fragile materials can be held firmly and without distortion, according to manufacturer.

Units are available in either clamp-on (C-300) or swivel-base (S-300) models with 3-in. capacity.

R E Wilder, Inc, 26 Bedford St, Waltham 54, Mass

MORE DATA? Circle 122, inside back cover

Socket head capscrew called Pre-Lode has more wrenching area and an enlarged bearing surface, and is designed to eliminate indentation while using and maintaining full holding power under highest tensile load. Fasteners are available in all standard sizes from ¼ to 1 in.

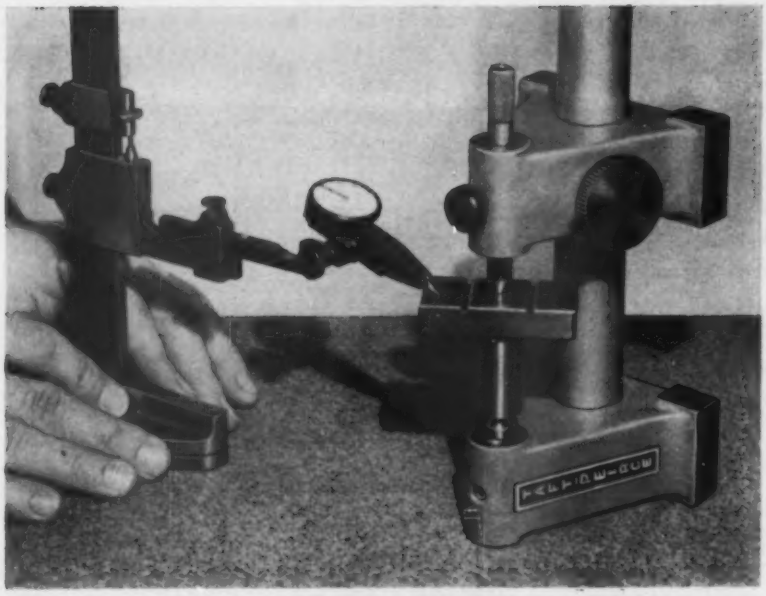
Parker-Kalon Div, General American Transportation Corp, Clifton, NJ

MORE DATA? Circle 123, inside back cover

Tool reconditioning service for solid-carbide tools will regrind worn tools and salvage broken or badly chipped tools. Service is also available on a contract scheduled basis. Ordinarily the tools are processed and shipped within 7 to 10 days of receipt at plant; same day service also available.

Dexco Corp, Raymac Div, 15490 Dale Ave, Detroit 23, Mich

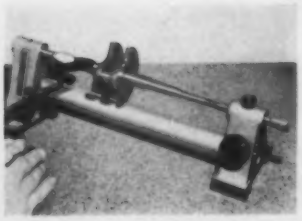
MORE DATA? Circle 124, inside back cover



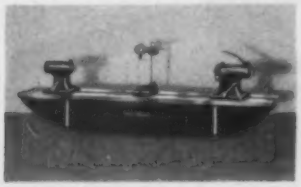
To indicate face runout, stand the Instrument Bench Centers vertically on precision ground headstock pads.

New!

Instrument Bench Centers Speed Inspection of Miniature Parts



No. 9205M Instrument Bench Centers checking miniature crankshaft for concentricity after O.D. grinding operation.



Complete Line Of Bench Centers

The Taft-Peirce Standard Bench Center Line includes models with work capacities from 8" dia. x 18" to 10" dia. x 60". Special sizes designed and built to order.

These new Taft-Peirce No. 9205M Instrument Bench Centers are specifically designed for speed, accuracy, and versatility in checking miniature and sub-miniature parts machined on centers.

When placed horizontally on a surface plate of known flatness, the centers line up automatically within close limits, and a quick turn of a knurled knob locks them in position. The entire unit may then be turned up on end to check runout and squareness of shoulders and sides of grooves.

An exclusive feature of the 9205M is an adjustable headstock center point that may be rotated to bring the work centers perfectly parallel to the surface plate. This allows the inspector to obtain a precise reading of concentricity and parallelism in a horizontal plane, and shoulder runout in a vertical plane.

Maximum capacity — 8" long x 3" diameter. Order today for your inspection department and for use beside the machine. Send for Bulletin ST-005.

TAKE IT TO TAFT-PEIRCE

TAFT-PEIRCE MANUFACTURING COMPANY
WOONSOCKET, RHODE ISLAND

"And don't you dare give anyone a raise until I get the house redecorated!"

INVENTORY...

By Paul Lockwood

Why, When, How

Physical inventory is a necessary headache. Here are some frequently asked questions, and answers to them that may help you in your inventory-taking and perhaps save tax dollars in your machine shop

QUESTION: ***Why is a physical inventory necessary?***

ANSWER: First, it is required by the Internal Revenue Code. "In every business in which the production, purchase or sale of merchandise produces income an inventory is necessary. The listing of unsold goods at the beginning and end of each year is required to correctly reflect the income for tax purposes."

Second, all of the stock purchased or produced during the year may not be sold during that year. This will result in a larger inventory at the end of the year than at the start, and will affect your profit. Or, the stock sold during the year may include all purchases or production plus some of the carryover from a previous year. This, too, affects your taxable profit.

QUESTION: ***Can a book inventory be used for reporting taxable income?***

ANSWER: Yes. The Internal Revenue Bureau permits the use of book inventories in Section 29.22. The book inventory is assumed to reveal the exact inventory position at any given date and can be used for tax reporting. The Code requires that the balances shown on the book inventory

"Not only are the cigars he hands out the best, but his taps and drills seem to outlast. . . ."

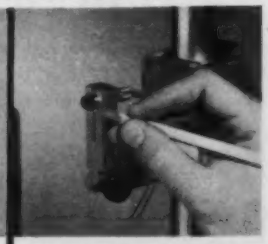
The Taft-Peirce CompAIRator... all-in-one package for gaging, size sensing and measuring

This is the Taft-Peirce Model E CompAIRator with hose-mounted standard Air Plug Gage. The Model E features fast, visual readout, extreme accuracy and great versatility. Air Plug Gages are used for through-hole, blind hole and counter-bored hole inspections. Very small holes and bores with limited depth can also be handled.

CompAIRators are simple, portable units for bench or machine inspection, for adaptation to in-process gaging; and for use with a variety of fixtures for shop-wide use.

Air Ring Gages measure external diameters from .125" up. Three nozzle design available for checking centerless ground diameters.

Air Snap Gages used with the Model E CompAIRator provide greater economy and more gaging flexibility for checking production or job lots.



The new Air Capsule provides direct contact gaging adaptable to a wide variety of applications. Replaces standard AGD dial indicators.

The new Model E CompAIRator is a compact, low-cost basic air gage for use with a wide variety of gaging accessories. It features the exclusive Taft-Peirce Velocity circuit which produces fast, accurate readings, and can be quickly changed to any one of four magnifications for extra versatility. The smallest diameters — ID's to .055" — can be checked, as well as tolerances from .0001" to .125".

In addition to the standard features shown above, special fixtures can be designed for practically any application. Maximum economy can frequently be obtained by using two-and-three-dial CompAIRators to measure combinations of dimensions at the same time, thus saving time and increasing accuracy.

Try Taft-Peirce CompAIRator Gaging in your Plant. Your nearest Taft-Peirce representative is ready to show you the Model E CompAIRator plus examples of a wide variety of gaging systems which can save you time and money. Call or write today.

TAKE IT TO TAFT-PEIRCE

TAFT-PEIRCE MANUFACTURING COMPANY
WOONSOCKET, RHODE ISLAND

Zagar Gearless Drill Heads

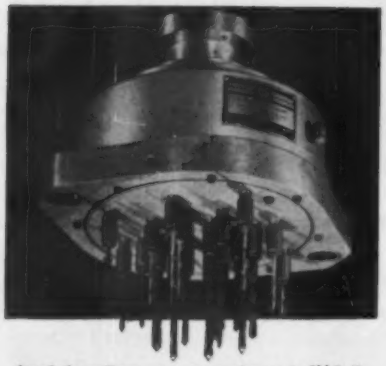
put 4 big advantages to work for you

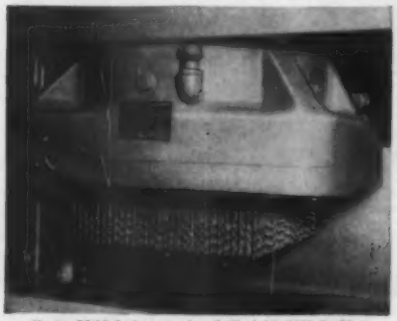
Any number of holes

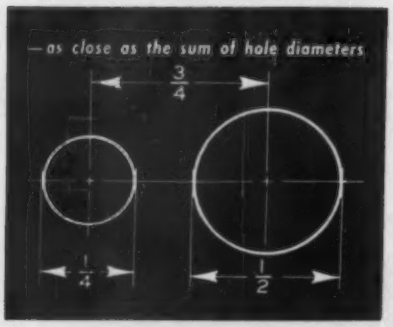
Any hole pattern

Any material

On all centers


Any hole pattern—on any center up to 1½" dia.


Up to 1200 holes can be drilled IN ONE PASS.



A Zagar drill head is never obsolete. Zagar can re-locate spindles for other hole patterns.

Can you visualize the savings made possibe by drilling up to 1200 holes at one pass? Zagar standard practice can handle any machinable material up to 1½" diameter. Holes of varying diameters can be drilled to form any pattern. Zagar Gearless Drill Heads, their efficiency proven by many years' success, can be installed on existing drill presses. Or, Zagar will lay out the necessary tooling for your entire job. May we see your sample parts and study your requirements? There is only one *right* answer — one *best* answer — for those requirements. May we supply it?

Get more information via Zagar's Engineering Data Sheets.

ZAGAR INCORPORATED
23886 LAKELAND BOULEVARD, CLEVELAND 23, OHIO

Zagar TOOLS FOR INDUSTRY and SPECIAL MACHINERY

be verified at reasonable intervals by physical inventories of the stock.

QUESTION: ***When should the physical inventory be taken?***
ANSWER: The Internal Revenue Code says, "The inventory of unsold goods on hand at the beginning and end of each year is required." However, the year referred to is a taxable year—a fixed period of time not longer than twelve months.

Many taxpayers automatically consider December 31 as the time to take inventory. If you report on a calendar-year basis, the inventory at this time must be reported. However, for practical purposes, the *physical* inventory is often taken at dates other than December 31. When this procedure is followed adjustments must be made in your book inventory to bring it into line with the physical stock count.

Machine shop management suggests that these times for taking a quicker and easier physical inventory be adopted:

1. When stock is at a low point
2. When plant activity is slow
3. When the shop is closed—(vacation, for instance)

These times minimize confusion and lead to a more accurate inventory. With stock at a low point there is less to count and list, thus there is less chance for error.

QUESTION: ***What should be included in the physical inventory?***
ANSWER: The easy answer is everything. But, to be more specific, here is a check list of items to include:

1. All finished goods
2. Goods in process
3. Raw materials
4. Supplies—if for sale, or to become part of the finished product offered for sale
5. Goods in transit—if you have title
6. Goods on consignment—if you have title

QUESTION: ***How should goods in process be valued in the inventory?***
ANSWER: The Internal Revenue Code spells out three things that should be considered in arriving at the inventory value for goods in process. They are:

1. Cost of all raw materials and supplies used in the process to date
2. Direct labor costs to this point in production
3. A reasonable amount of overhead including all management expenses

Selling costs are not included in

(continued on page 287)

ALLEN HEX-SOCKET SCREWS HEAD

HERE'S ALLEN TODAY!

What this new Allen plant means to you...

If hex-socket screws have any place in your life at all, our new plant at Bloomfield, Connecticut, has unlimited advantages for you!

If you are a distributor of Allen products, for example, this new plant and its expanded facilities for engineering and production mean prompter shipments than we have ever before been able to give you, and both new products for your customers and improvements in existing products—all coming along rapidly now that we have the room we need, and the new equipment we have wanted. If you're an engineer or designer, the modern facilities of this new plant make available to you greatly increased engineering and metallurgical services in the development of dependable fastening for the products you're designing—and higher standards of precision than ever before. If you're a manufacturer, this new plant of ours is bound to be a rich source for new ideas in fastening, and new products that will make your own products better.

We've picked a few interesting highlights to show you here ... but there are too many things by far to put on paper! This new plant has to be *seen*.

Malvern J. Mather

MALVERN J. MATHER, *President*.

Allen's Quality Control Division has been greatly expanded. At left, thread form and lead of a socket head cap screw are inspected on a J&L optical comparator. Next is the gage control section. At right, technicians measure pitch diameter by the 3-wire method, to an accuracy of .0001, and inspect surface finish of Allen Dowel Pins to an accuracy of 1 microinch R.M.S.

Ample room to work effectively characterizes every department of this new plant. This section of the new metallurgical laboratory shows two Tinius Olsen tensile machines, and precision testing equipment in the background. The laboratory has a metallograph room, and a special fatigue testing room.

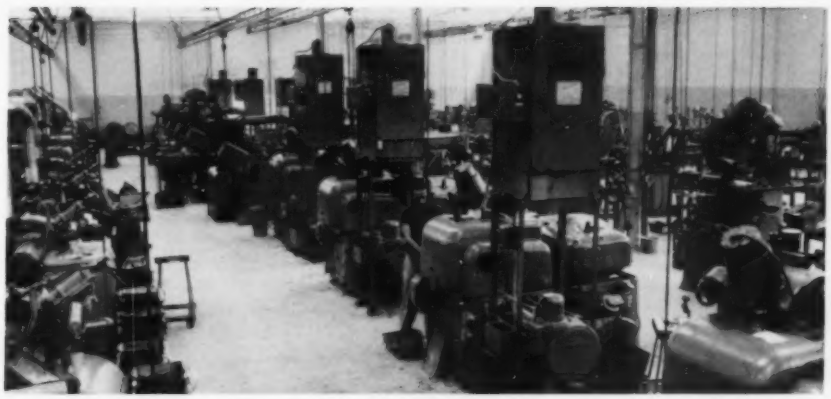
Here's ample room for storing a tremendous inventory of wire and bar stock, so that any type or size is instantly available for processing. A unique conveyor system, designed specially for Allen, handles bar and rod stock.

A FEW FACTS ABOUT OUR NEW PLANT...

About seven miles from Hartford, our new plant is located on a 32-acre site in Bloomfield, Connecticut, with plenty of room for substantial expansion. The plant comprises a 250,000 square-foot single story factory section, and a two story 20,000 square-foot office building, connected by a glass enclosed corridor that also serves as main entrance and reception room.

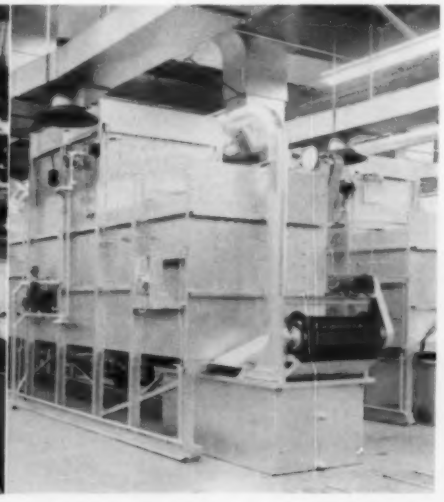
The open, almost partitionless, layout of the factory section permits an extremely efficient production flow around the perimeter of the building. A central core within this circular production line provides for service functions, such as quality control and testing, storage, tool cribs, and maintenance.

Layout and construction of the new plant were worked out over a two-year period, with scale models of all equipment. New equipment has all been specially designed for this new plant, to make it the most modern facility anywhere for production of hex-socket screws and related products.



In this section of the large grinding department is a battery of centerless grinders for production of ground thread set screws to Class 3A and special thread fits. Coolants are kept clean by magnetic separators, and precipitrons maintain clean working atmosphere.

Part of the heading department, where socket screw products are blanked by cold, warm, and hot heading processes. Large machines in foreground are progressive headers for manufacture of large-size socket screw products.



Our new heat treating department was specially engineered for this new plant. Shown are two new Holcroft units for hardening, quenching and washing, and tempering. Not shown here is new AGF rotary furnace for carburizing dowel pins.

A very large area is allocated to finished products storage, enabling us to make prompter shipment of a wider range of standard stock items. Flow is rapid and direct from these racks, to the shipping department in the rear, and on to the large truck dock just beyond.

These precision products have made ALLEN the number 1 name in the socket screw field!

Leader Point Cap Screw

Allen Button Head Cap Screw

Allen Flat Head Cap Screw

Allenut

Allenpoint Set Screw

"Tru-Round" Pipe Plug

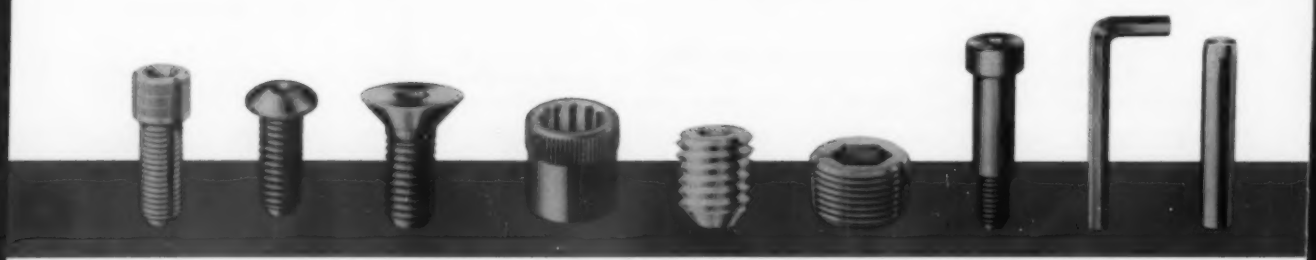
Allen Shoulder Screw

"Tru-Ground" Dowel Pin

Allen Hex Key

ALLEN
HEX-SOCKET SCREWS
HEAD

ALLEN Hex-Socket Cap and Set Screws, and related products, are stocked and sold by leading Industrial Distributors throughout the country.



THE ALLEN MANUFACTURING COMPANY

HARTFORD 1, CONNECTICUT

Plant at Bloomfield, Connecticut • Warehouses at Chicago and Los Angeles

PRINTED IN U.S.A.

the valuation of any goods in process or in finished goods to which you hold title.

QUESTION: ***Can a machine shop take depreciation on its inventory?***
ANSWER: No. According to Section 29.23 of the Internal Revenue Code, inventories are not depreciable property. Your ending inventory of last year and your beginning inventory of this year should be identical.

QUESTION: ***How should unsaleable supplies and materials be valued in the inventory?***
ANSWER: Items not saleable at normal prices or in the normal way, should be valued at a reasonable selling price. If there is a direct selling cost or disposition cost in liquidating these unsaleable items, this is taken from the fair value.

QUESTION: ***How should the inventory be valued?***
ANSWER: There are four methods that that can be used for the inventory in your machine shop. They are:

1. *Cost.* This is the invoice cost minus any trade or other discounts. Cash discounts can be taken from the invoice price or credited to a cash discount income account as long as the policy is consistently followed.

2. *Cost or Market, whichever is lower.* When your machine shop inventory is valued (end of taxable year), the invoice cost and current market values of each item are compared. The lowest price—cost or market—is used for your inventory valuation and for tax reporting.

3. *FIFO.* This assumes that the supplies and materials first acquired were the first sold, hence the name—First-In, First-Out.

4. *LIFO.* This method (Last-In, First-Out) assumes that the last stock acquired was the first sold. Thus, the remaining inventory represents the materials and supplies on hand for the longest time.

The method selected for the first inventory must be used consistently and for the complete inventory (except with LIFO, which can be for one part of the inventory).

QUESTION: ***Can a machine shop change the method of inventory valuation used?***
ANSWER: Yes. You must obtain permission from the Commissioner. Apply within 90 days after the beginning of the taxable year to be covered by the return.

To change to LIFO, you file Form 970 in triplicate with your income tax return for the taxable year cov-

Atrax PROGRESS REPORT

SOLID CARBIDE TOOLS

CASE HISTORY #19
MAJOR AUTOMOBILE MANUFACTURER

Atrax BORING TOOL Series 2010

OPERATION: Boring 20 holes around 4½" O.D. x 3" I.D. Stator Blade Rings
MATERIAL: Cast Iron
SPEED-FEED: 8,000 r.p.m. at 10" per min. stock removal .014"
PRODUCTION: 10,000 holes per grind. Use of this Atrax tool reduced number of special machines needed to maintain production from 18 to 6.

CASE HISTORY #30
MID-WEST PUMP MANUFACTURER

Atrax SOLID CARBIDE BUR Shape A-184

OPERATION: Plunge cut to ¼" depth using milling machine
MATERIAL: Beryllium Copper
SPEED-FEED: Slow speed-hand fed
PRODUCTION: Extremely fine surface finish resulted with virtually no wear on Atrax Solid Carbide Bur.

CASE HISTORY #31
EASTERN AIRCRAFT MANUFACTURER

Atrax END MILL Series 1505 (Slow Spiral)

OPERATION: Reworking and salvaging hardened dies and fixtures for retooling program
MATERIAL: Hardened steel Rockwell C-58 and case hardened materials
SPEED: 1200 r.p.m. with hand feed
PRODUCTION: Atrax Solid Carbide Slow Spiral End Mills used on this rework and salvaging application proved extremely successful in time and material savings.

Atrax

SEND TODAY for 96 page "STANDARD REFERENCE" on Carbide Tooling!

THE ATRAX COMPANY
Newington 11, Connecticut

NEED A LARGER PUMP?

We can supply you with larger type centrifugal pumps for pumping coolant, some acids, oils. These pumps can—

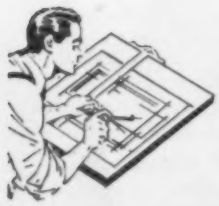
- Pump up to 400 gallons per minute, maximum.
- Pump up to 90 foot head, maximum.

Sealess and seal type pumps, immersed or flange mounted.

They are also adaptable for high temperatures up to 600° F. equipped with fan, lantern and non-friction grease seal for fumes, etc.

or smaller pumps too...

Don't forget that Ruthman has a complete line of smaller centrifugal pumps from 1/30 horsepower. *Write for our complete catalog.*



Have you a pump problem?

As specialists in the design and manufacture of Centrifugal Pumps, we are ready to help you with any *Centrifugal* pump problems. Just call on us any time.

THE Ruthman MACHINERY CO.

1819 Reading Road, Cincinnati, Ohio

- COOLANT PUMPS
- CIRCULATORS • AGITATORS
- MOLTEN METAL PUMPS

ered. Once adopted, LIFO must be continued unless the Commissioner requests a change or you apply for, and are granted, authority to change.

QUESTION: ***Are there any inventory practices that may cause trouble for a machine shop?***

ANSWER: Yes. In Section 29.22 of the Internal Revenue Code, these things are specifically listed as wrong:

1. Deducting a reserve for price changes or depreciation allowance
2. Using a nominal value for goods in process rather than a proper value
3. Failing to include part of the inventory
4. Using a constant value for inventory without a physical count
5. Counting stock in transit when you do not have title

QUESTION: ***How can a machine shop save time and money in taking a physical inventory?***

ANSWER: Here are some suggestions machine shop managements have found helpful in reducing the time for taking inventory and keeping costs at a minimum:

1. Plan the inventory well in advance
2. Make a map of the shop to be sure everything is counted—and not counted twice
3. Organize stock for quick, easy, and accurate counting
4. Select, assign, and instruct employees for inventory
5. Provide control of listing sheets to avoid omitting part of inventory or taking some parts twice
6. Spot check during the physical count to be sure it is accurate.

"Oh well, I guess he couldn't be expected to know much about machinery—spending most of his time in the gymnasium."

FIELD REPORT...

Ford-Lorain goes into operation

Innovations galore are the order of the day at Ford Motor Co's new Lorain, Ohio, assembly plant, which has gone into operation with the advent of 1959 model Ford cars and trucks. For instance: executives carry tiny electronic paging systems around in their pockets. When they're wanted, the plant telephone operator flips a switch on a coding machine and the shirtpocket set emits a beeping sound. The pagee simply uses the nearest telephone to find out who wants him.

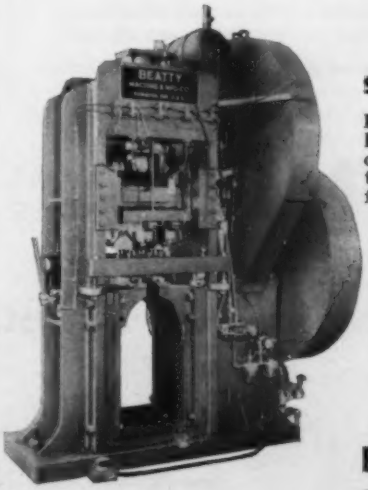
This is just one of a number of new wrinkles installed at Ford's Lorain plant, recently set up to add capacity for the production of '59 cars and trucks. Another new idea is putting all paint operations upstairs on the second floor—thus removing spray booths and freshly painted parts from shop areas where dust is a present problem. Primer coats are applied electrostatically to obtain about 95% paint effectiveness, compared with about 60% achieved by ordinary spraying operations.

More than 300,000 square feet of working area is devoted to painting, masking, drying, and cleaning. Operations begin in a central room where 44 mixing and circulating tanks churn the paints, cut them to spraying viscosity, and pump them to any of 10 spray booths. Each tank holds 60 gallons and there are two tanks for each color used. The spray booths contain hose outlets for all colors, so that operators merely move their spray guns from one hose connection to another to change a paint color. Air exhaust and water

"And Quentin there is designing a sound that will travel faster than planes."

BEATTY EQUIPMENT IN YOUR SHOP MAKES HIS JOB EASIER, TOO!

On the job, erecting the structural steel which you fabricate, the precision, speed and accuracy of Beatty Machines pays off big for your customers, too! That's because Beatty equipment is engineered for maximum accuracy and speed in heavy metal-working — punching, slotting, bending, flanging, forming. Beatty machines help you deliver the goods on time, speed fabrication by reducing set-up time and material handling. The new Beatty No. 7 Detail Flange Punch, for example, flange-punches I-beams in only two passes where ordinary equipment requires four passes. Look to Beatty for heavy metal-working equipment — a complete line of punches, presses, shears, bulldozers.



SPECIFICATIONS

BEATTY NO. 7 DETAIL FLANGE PUNCH — 100-ton cap., mechanically driven guillotine-type. Punches 1¼" hole through 1" mild steel and handles beams from 6" to 36".

Write For Full Details

BEATTY MACHINE & MFG. CO.
948 150th St., Hammond, Ind.

CIRCLE 313 READER SERVICE CARD

NEWS ABOUT MACHINE MOUNTS

Unisorb offers three cost-saving benefits for installing machines and equipment . . . Legs or framework can be solidly secured to the floor without bolts or lag screws; No danger of machines "walking"; and Up to 85% of transmitted vibration is absorbed.

Precision machines need a special type Unisorb mounting. Centerless Grinder, left, was installed quickly, without bolts or lag screws; Milling machine, right, is mounted on Unisorb LEVEL-RITE MOUNTS for quick, precise level.

Every machine has a vibration "personality". Different machines require different densities. Only Unisorb provides the right density and thickness.

TRY UNISORB ON OUR TRIAL OFFER! Let us send you the right density and thickness for a specific machine. If you're not satisfied, return within 30 days and we'll cancel the invoice. Write or call, today.

UNISORB 200 SOUTH ST. BOSTON, MASS.

Division of The FELTERS Company

Want more information? Send for set of Unisorb "Facts" Books!

Please send me a set of Unisorb "Facts" Books and trial offer request.

Company.....

Name.....

Address.....

City.....Zone.....State.....

Field Report . . .

wash systems are combined to remove surplus paint particles. The water is continually filtered and recirculated through the booths.

Prior to painting, all parts are coated with zinc phosphate for chemical cleaning. This also acts as a rust inhibitor. Two coats of primer are applied to each part and a cleaning process follows before the enamel is sprayed on—also a two-coat application.

Materials handling at Lorain includes such recent developments as small propane-powered tow trucks with trailers. These trains travel over 7.5 miles of aisles, each pulling a string of trailers with average total loads of 8000 lb. About 400 men are employed in materials handling alone, piloting the trains and operating fork lift trucks.

More than eight miles of overhead and floor-level conveyors have been installed for assembly operations in addition to nine 20,000-gallon underground storage tanks for fluids and coal. Rail docks can accommodate 54 box cars inside the plant at one time for the daily delivery of 2.5-million lb of material and parts. Truck docks can handle 18 trucks at a time, and about 1.5-million lb of raw material are delivered to the plant by this means every day.

All of this is tied together by means of a new communications system which actually begins at a Ford district sales office, where each customer's order is recorded and a coded card is prepared. Data on this card covers the required body type, color, transmission, engine and other options. At the assembly plant, the coded card goes to a central control room where all this information is

"But, Mr Jackson, I haven't made the same mistake twice! I took too much off the other end this time!"

ANNOUNCING . . .

NEW PERFECTION IN SAW BAND WELDS

having 3⅓ times longer FLEX LIFE

Regardless of the type of machine you use, this new DoALL saw welding service improves your sawing applications and reduces your saw blade costs. New techniques and new welding equipment—developed by DoALL for custom-welding of saw blades to specified lengths—assure you of a superior weld. Yet, this improved welding service is offered at no increase in price.

Here are guaranteed advantages of DoALL marked weld:

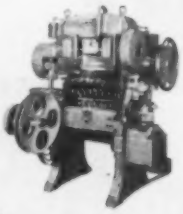
1. **Welds are stronger** than the welded areas produced by any other equipment available. This is important because all saw bands must be joined by welding. And the tool is no better than the welded section. The DoALL identification stamped in the welded area is your positive guarantee of a better weld.
2. **Teeth are perfectly matched.** Mismatched teeth are a thing of the past. So are uneven welds and weld breakage. A uniform cutting edge with no off-beat spacing of teeth insures smoother performance, maximum precision at all times. This perfection of weld and the guarantee of tooth set, hardness and tooth form make DoALL saw bands ultra-precision cutting tools.
3. **No undercut by grinding wheels.** Note the upper illustration at left. This undercutting is typical of what happens when the welding flash is removed by grinding wheels. The thinner section and annealing caused by grinding heat are responsible for many saw band failures. The DoALL weld shown below it is smooth and uniform and will not "click" as it goes through the guide.
4. **Saves you money . . . cuts welding costs.** This new DoALL custom-welding service costs less than doing it in your own shop. Each band is clearly marked as to blade type, width and pitch so that the operator can positively identify the right tool for the specific job. This service, covering both carbon and high-speed steel blades, is available *only* through your local DoALL store. Orders are filled promptly. Telephone your local DoALL store today.

SB-65

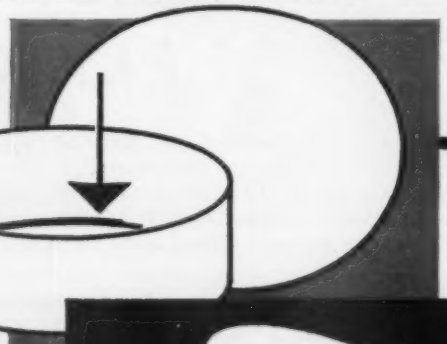
The DoALL Company, Des Plaines, Illinois

THIS IS A TYPICAL DoALL STORE

ASK ABOUT BAIRD'S
production bonus
on parts like these



The Baird "PRODUCTION BONUS" is the worthwhile sum of TIME, TOOLING and MATERIAL cost-savings effected by BAIRD MULTIPLE TRANSFER PRESS features NOT found in other machines or methods producing 150 pieces per minute.



for example

BLANKING and CUPPING for this electric lamp screw base are done at the blanking station on the same press that completes the part.

NO SECONDARY OPERATIONS required for side-piercing (back and front).

THREAD-ROLLING—again on the same press—completes this part. Thread-rolling attachment is cycled to the press speed.

From strip to finished screw base on ONE machine with ONE basic tooling, at a production rate of 150 pieces per minute!

Ask Baird about this unique high-production method . . . adaptable to a wide range of bases, ferrules, and other small drawn parts requiring multiple operations. Write Dept. AM.

THE BAIRD MACHINE COMPANY
STRATFORD • CONNECTICUT

BAIRD

Six and Eight Spindle Chuckers • Automatic Multiple Spindle Presses • Automatic 12 Station Duplex Turning Machines • Vertical Continuous Lathes • Automatic Four Slide Machines • Presspinners • Rubber Metal Forming Machines • Special Finishing Machines • Machinery for Close and Roller Chain Production • Conveyor Hook and Eye Production • Precision Bench Presses

68A78

Field Report . . .

transferred to a punched tape. The tape is fed into a master teletype machine which relays the data to 17 receiving stations at strategic points in passenger car buildup areas. A similar machine transmits to 14 additional stations in the truck assembly area.

At each strategic point the requested component is placed on a conveyor for transfer to the final assembly line. Precise coordination is thus established among all departments so that an engine, for instance, arrives at final assembly at the exact moment the chassis for which it is intended passes the engine transfer point.

Quality control has been made equally effective as the result of studies made at a model pilot plant at Ford Division's Quality Control Center in Allen Park, Mich. Here, assembly techniques for '59 models were studied for months before production began. As a result assembly line flaws were picked up before actual production started.

The quality control program resulting from this work emphasizes use of inspectors at strategic points in every department in the plant.

Charts, gages, road test equipment, leak testing devices, and numerous other quality control tools are also used extensively.

Flying Tigers Expand

Two more Lockheed Super-H Constellations have been bought for approximately $5.6 million by the Flying Tiger Line as the first step in a new expansion program.

"You've certainly come a long way, Ed. I can remember when you used to bring your lunch in the Evening Tribune!"

Aluminum Gains Ground In Auto Usage

Potential applications of aluminum in the automotive industry, backed up by examples of how European automakers are already using the metal, keynoted a recent press conference held by Reynolds Metals Co at the Detroit Athletic Club.

On display during the Conference, for instance, were aluminum Fiat transmissions, brake drums for the Mercedes 300, 300 SL and the Porsche, brake support plates for the Mercedes, brake shoes for the Rokal and Mercedes 190 and 300, a steering housing base for the Opel, an axle part for the Porsche, a BMC steering gearbox, and a Lloyd-600 transmission—all made by the permanent-mold process.

Among aluminum die castings shown were a Citroen oil pan, a Simca oil pan, a Mercedes 300-SL valve cover, a Renault steering housing, and a Vedette bell housing.

Sand cast aluminum parts included a Mercedes 190-SL intake manifold, and an exhaust manifold and oil pan for the Mercedes 300-SL.

Semi-permanent mold castings shown included steering housings, front-and-rear torsional suspension housings, and rear-axle gear housings for BMW.

In the U S car field, Reynolds is said to be quoting aluminum bumpers, panels and similar parts from Ford production prints—and it is rumored that Ford is planning an aluminum V-8 for its 1960 models, which will have cast iron cylinder sleeves bonded to the cylinder walls, and which will be die-cast in a huge Cast Master machine, which is now on order.

Chrysler, too, is said, is planning an aluminum 6-cylinder, in-line engine with 172-cu-in. displacement. Cylinder wall sleeves in this engine, it is said, will also be of cast iron.

Boeing To Make B-70 Wings

Boeing Airplane Co, Seattle, has been awarded a subcontract to manufacture wings for the B-70 supersonic chemical bomber from North American Aviation. Value of the subcontract may amount anywhere from $80 million to $200 million, depending upon how many B-70s the Air Force decides to make. The subcontract will provide about 3000 jobs for Boeing for four years or more, alleviating Boeing's bitter disappointment over not getting the prime contract on the B-70.

North American selected Boeing over Douglas, Lockheed, Convair

FREE BROCHURE TELLS HOW YOU CAN GRIND PRECISION HIGH PRODUCTION DIES

IMPORTANT TO YOU!

Free booklet tells how VISUAL GRIND facilitates construction of precision high-production dies, dies for powder metallurgy, lamination dies and special purpose dies. VISUAL GRIND permits through, blind and templet grinding . . . permits continuous inspection by magnifying work from 10:1 to 100:1 . . . upgrades semi-skilled labor . . . permits easy maintenance of dies in your own plant . . . reduces costly down time. VISUAL GRIND COMPLETES YOUR TOOL ROOM.

Visual Grind solves the problem in mind

Intricate grinding jobs like those shown above ordinarily involve several machines. ALL WERE FORM GROUND ON A SINGLE VISUAL GRIND.

CLIP and MAIL THIS COUPON TODAY

The CLEVELAND GRINDING MACHINE Co.

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Please send me the free brochure describing the capabilities of the VISUAL GRIND.

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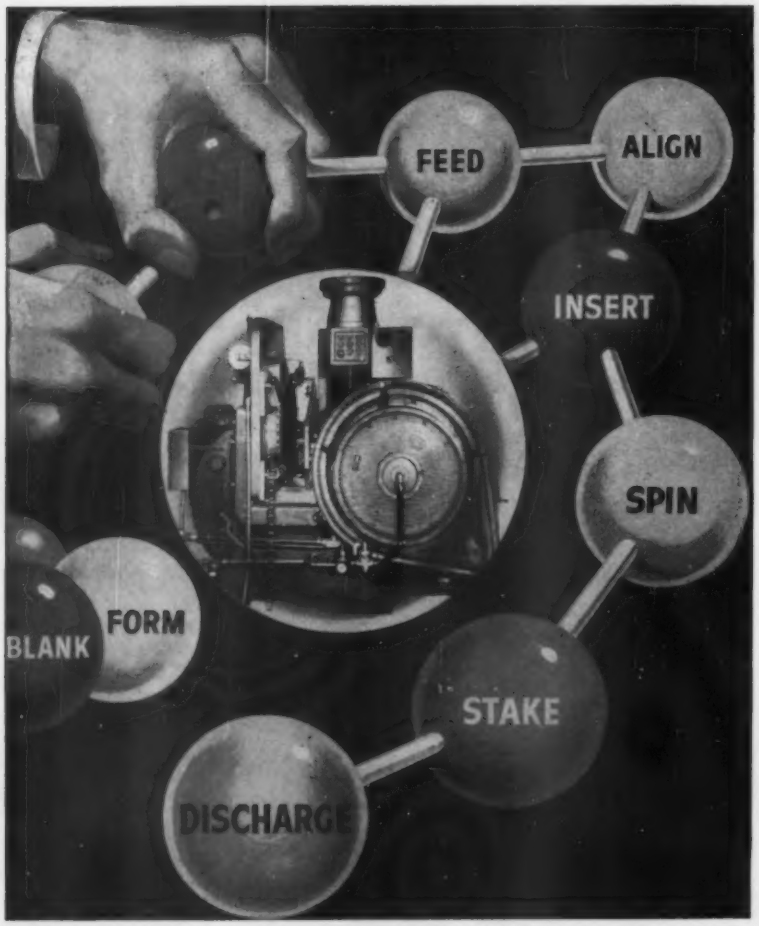


V & O TOOLED PRESSES

REDUCE DIRECT COSTS BY ELIMINATING THEM

For example, the press shown above brings together five parts, spins a pin at both ends, performs a staking operation and delivers continuous, linked chain. Operator simply loads links into a magazine and keeps hoppers filled with pins. Press does the rest – even automates quality control.

By tooling presses that combine jobs, V & O eliminates the material handling, semi-finished parts transfer and in-between inspection involved in non-integrated operations. For the majority of requirements, V & O uses standard types of V & O presses and standard types of feeds and accessories.

Perhaps you have ideas on how operations in your plant can be integrated to reduce direct costs. We would welcome the chance to discuss them with you. It's highly possible that we have already engineered units that, in principle, will meet your requirements.

Presses, special equipment and methods that automatically reduce costs

EMHART MANUFACTURING COMPANY
THE V & O PRESS COMPANY DIVISION
301 UNION TURNPIKE • HUDSON, NEW YORK

Field Report . . .

and Martin because of its fine facilities for wing assembly at its Plant II, where B-52 production is now phasing out.

Electra Contract to Lockheed

Navy has awarded a $10-million contract for pre-production work on the P3V-1 Electra anti-submarine-warfare patrol plane to Lockheed Aircraft Corp. The new contract, covering "substantially increased work" during the next 12 months, will permit such manufacturing activity as production planning and master tooling layout.

Bristol-Aerojet Ltd Formed

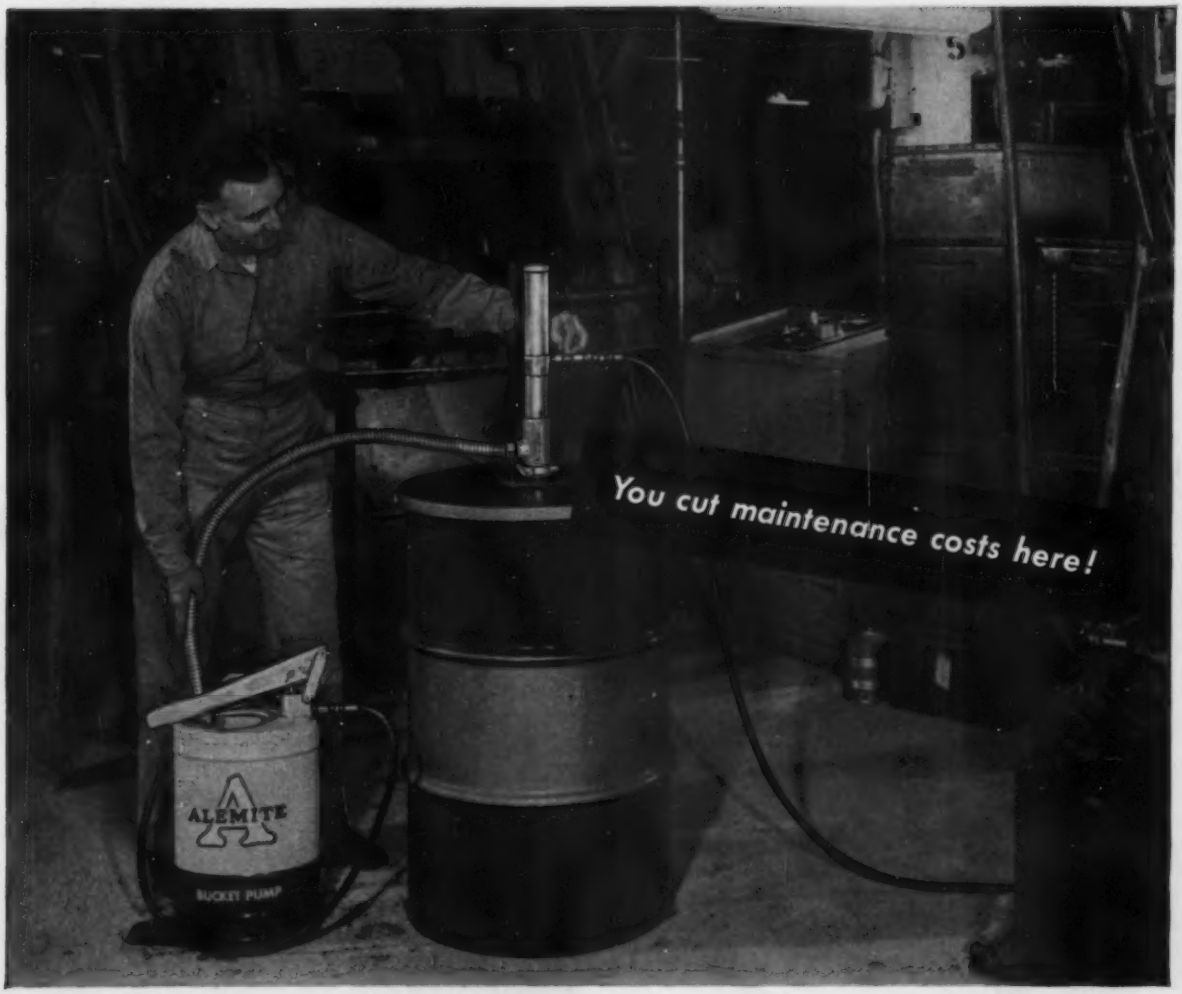
Aerojet-General Corp, Azusa, Calif, and Britain's Bristol Aeroplane Co Ltd have agreed to form a new joint company, Bristol-Aerojet Ltd, to combine the two firms' solid-rocket motor technology. The joint company's plant will be situated in England, and will be devoted to the development, manufacture, casting and testing of rocket motors. Under the agreement, Bristol-Aerojet will have exclusive right to exploit Aerojet solid-propellant rocket products within the field of the agreement in the United Kingdom and the British Commonwealth.

$1.5 Million to Servomechanisms

Three new contracts, valued in excess of $1.5 million, have been awarded to Servomechanisms Inc, Hawthorne, Calif, for its barometric altitude controller by Hughes Aircraft, Radio Corp of America, and for its liquid tanking computers by Hayes Aircraft Co.

(continued on page 299)

"Well—is this the same gay, mad, carefree machinist who regaled us with his delightful clowning at the company picnic only this week-end?"



Alemite Power Transfer of Lubricants Is 63% Faster Than Hand Method!

Wherever old-fashioned hand methods are used to transfer lubricants from original drums to other containers, time and money are wasted!

This high-speed, air-powered Alemite Transfer Pump transfers 37 pounds of pressure gun grease per minute, direct from original drum to loader pump, bucket pump or power gun. This gives you 63% faster transfer than by hand! And lubricant is always sealed—fully protected against mess, waste and contamination.

Pump also handles alcohol, cutting oils, kerosene—almost any non-corrosive, non-abrasive fluid used by the drum. Synthetic rubber air piston requires no oiling. Fully adjustable delivery rate . . . weighs only 15½ pounds!

Step up to fast-moving, time-saving transfer of fluid and semi-solid materials. Check Alemite's complete line of lubrication equipment for industry.

Symbol of SW Excellence

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DIVISION
STEWART-WARNER
CORPORATION

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Please send me your complete catalog of Alemite industrial lubrication equipment.

Name .....

Company .....

Address .....

City ..... Zone ..... State .....

NEWS!

FRAUENTHAL BREAKS ANOTHER ROCKET-AGE MACHINING BARRIER

NOW PRODUCING

Frauenthal 60" dia. Contour Finishing Machine with 15' length capacity designed and built for Walter Kidde & Co., Inc.

Now... machining and grinding nose cone and radome contours for aircraft and I. C. B. M. re-entry missiles . . . FRAUENTHAL Rocket-Age machines are here!

NOW PRODUCING

Frauenthal 36" Tracer Controlled Contour Grinder at work on a typical radome shape — also available in larger sizes.

NOW PRODUCING

Frauenthal Precision Contour Turning and Finishing Machine. Producing to accuracy of ± .0005 over entire 60" diameter contoured surface, with 4 RMS maximum finish on re-entry nose cone.

Developed for AVCO Research and Advanced Development Division on the Titan program.

Frauenthal is doing it *right now* — contour machining, grinding and micro-finishing metal, fiber glass and ceramic nose cones for America's Space-Age missiles.

These creatively designed machines can generate nozzle throat contours for rocket motors, lay up or wind resinoid bonded material on formed mandrels, contour turn and grind mandrels or other difficult-to-work shapes and materials.

Contact Frauenthal now for forward-thinking machine designs. You'll get advanced engineering that *anticipates* your current and future requirements. All to help you profitably BREAK THROUGH in your field of operations.

FRAUENTHAL

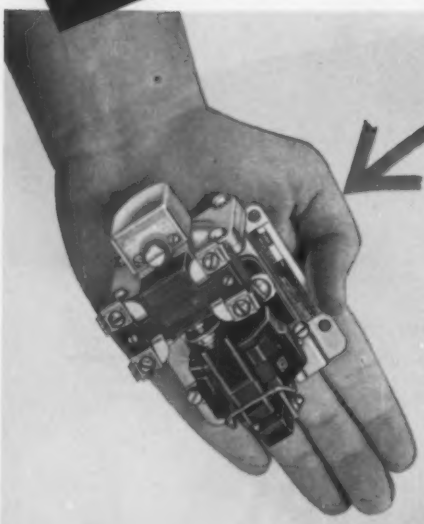
DIVISION

THE KAYDON ENGINEERING CORP.

MUSKEGON, MICHIGAN, U. S. A.

What's Your Timing Problem?

-ONE OF THESE TIMERS WILL DO YOUR JOB *Exactly!*



NEW...Type A

REALLY SMALL IN SIZE AND COST!

for applications requiring shorter timing periods, ±15% accuracy and no interlocks

Type B

MACHINE TOOL STANDARD FOR MORE THAN 20 YEARS!

for applications requiring timing periods up to 3 minutes, maximum accuracy and 1 or 2 instantaneous interlocks

COMPARISON	TYPE A	TYPE B
Timing Period	.2 to 1 min.	.2 to 3 min.
Accuracy	±15%	±10%
Interlocks	None	Max. 2 Double Circuit
Panel Space	2⅜" x 4"	2½" x 7⅜"
Convertible Delay-On • Delay-Off	Yes	Yes
Maximum Voltage AC—DC	600 V. AC only	600 V. AC 250 V. DC

Write for Timer Bulletin 9050
Address Square D Company, 4041 North Richards Street, Milwaukee 12, Wisconsin

NOW...EC&M PRODUCTS ARE A PART OF THE SQUARE D LINE

SQUARE D COMPANY

Field Report . . .

Expanded Expansion
A month or two ago Metals Engineering Corp, which has just recently moved into Greeneville, Tenn, announced it would build a 50,000-sq-ft plant. Now, the company has changed its mind, will build a 120,000-sq-ft facility instead, will lease part of it to Southern Packaging Co.

Tools for Tennessee . . .
Murfreesboro Machine & Tool Co has just been organized at Murfreesboro, Tenn, will specialize in tool grinding, and make small parts and special tooling.

Open House at Marquardt
Marquardt Aircraft Co's modernized Jet Laboratory at Van Nuys, Calif, recently received a sendoff with an open house and dedication. So far this year Marquardt has increased its research, development and production facilities by more than 500,000 sq ft (all under one roof), and there's more expansion to come.

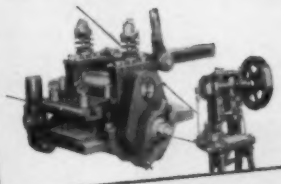
Boeing Lets Gyro Contract
Telecomputing Corp, Los Angeles, has received an additional contract from Boeing for production of floated rate gyros for the Air Force's Bomarc missile. This brings the total contract in force for the current year to $738,000.

Alabama Plant for Linde
Linde Products Division of Union Carbide Corp is planning to set up a new plant in the Redstone Arsenal, Ala, area to produce liquid oxygen, nitrogen and argon. This will make Linde's 36th plant in the South.

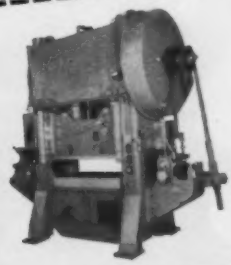
(continued on page 302)

"I take care of the kids' grievances, the shop steward takes care of yours, so I guess you're stuck with mine."

LITTELL ROLL FEEDS



LITTELL STYLE M FEEDS
6 sizes for single automatic feeding to standard presses. Feed stock up to .055" x 8", left to right or right to left. Feed length ranges, 0-2" through 0-4⅜" with plain gears and 0-4½" through 0-8½" with compound gears. Built for years of high speed, low cost automation feeding.



LITTELL STANDARD RACK AND PINION FEEDS
No. 6-12½ Littell Double Rack and Pinion Roll Feed mounted on brackets on right and left side of Straight Sided Press. Equipped with eccentric roll lifters. Littell Feeds to fit OBI presses are also available. Accessories such as oilers, straighteners and scrap cutters supplied at additional cost. Get catalog information.

AUTOMATE
YOUR PRESENT PRESSES FOR UP TO 5 TIMES MORE OUTPUT

Want more output from your present presses? Equipped with Littell Roll Feeds those presses will punch out two to five times more stampings per hour. These Littell Feeds are pre-engineered to fit standard OBI or Straight Sided Presses and they come ready to install. Delivery is fast, installation simple. Your investment comes back in a hurry through the increased output, lower stamping costs, operator safety and lower insurance rates.

GOOD DELIVERY
Enlarged plant, new equipment to speed delivery.

SEE OUR CATALOG IN SWEET'S

USE COUPON
to get full facts on Littell Feeds.

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4103 N. Ravenswood Ave.
Chicago 13, Illinois
District Offices: Detroit, Cleveland

F. J. Littell Machine Co., 4103 Ravenswood, Chicago 13, Ill.
Send Catalog Sections "A" Describing Littell Roll Feeds.

NAME _____
COMPANY _____
STREET _____
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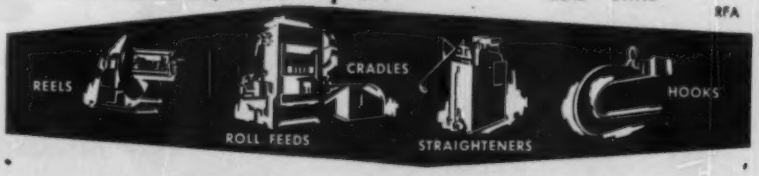
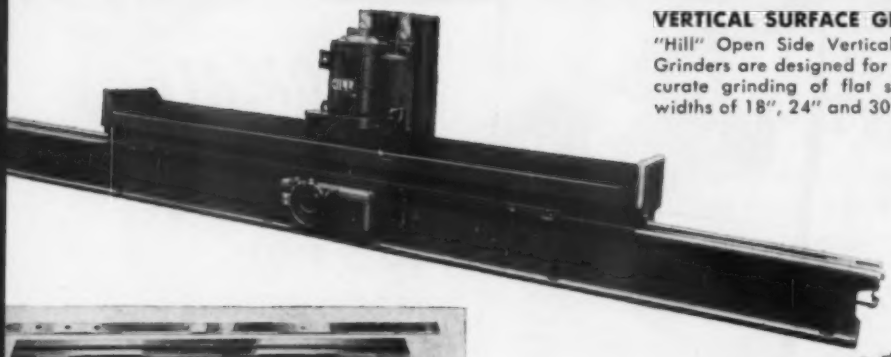
RFA



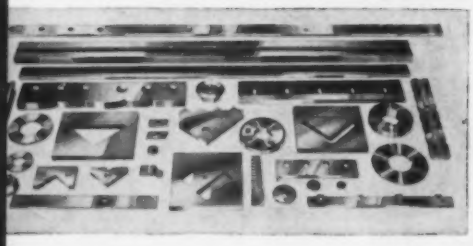
HILL ACME

HILL ACME TOOLS FOR INDUSTRY



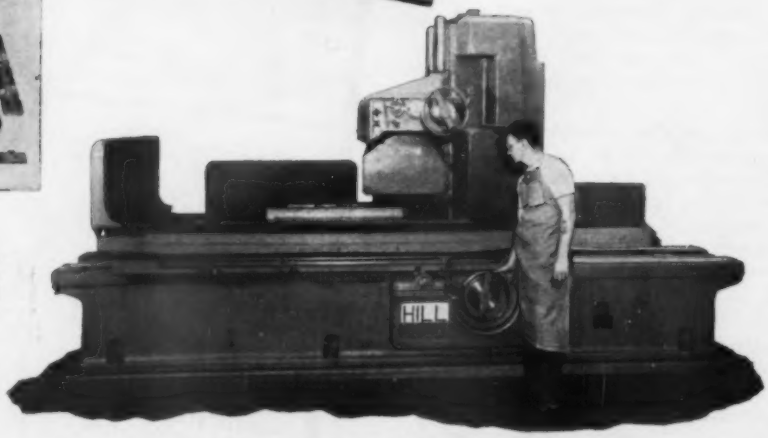
VERTICAL SURFACE GRINDERS

"Hill" Open Side Vertical Spindle Hydraulic Surface Grinders are designed for rapid stock removal and accurate grinding of flat surfaces. Furnished in table widths of 18", 24" and 30"; table lengths 60" to 240".



SHEAR KNIVES

"CLEVELAND" Knives and Shear Blades. Solid and laid steel shear blades; rotary slitting and side trimming knives; metal cutting machine knives.



HORIZONTAL SURFACE GRINDERS

"Hill" Open Side Horizontal Spindle Hydraulic Surface Grinders for accurate grinding of flats, angles, irregular and special shaped surfaces. Furnished in table widths from 18" up to 36"; table lengths 60" to 240".

ABRASIVE BELT GRINDING & POLISHING MACHINE

(Pinch Roll Type)

For pre-finishing, conditioning and polishing sheets, plates, strips or blanked-out shapes in flat form. Used as single units or in multiple units for progressive line polishing.

The basic HILL two-roll vertical head with endless abrasive belt. Used in both the Pinch-Roll and the Hydraulic Table types.

ABRASIVE BELT POLISHING MACHINE

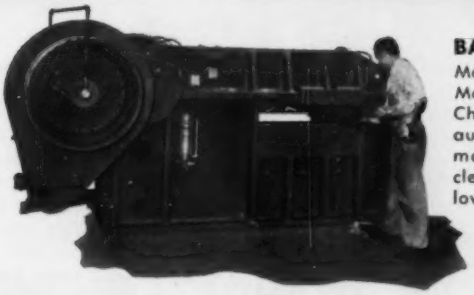
(Hydraulic Table Type)

For flat polishing of sheets and plates of ferrous and non-ferrous metals. Made in a variety of table widths and lengths with fully hydraulic reciprocating table.

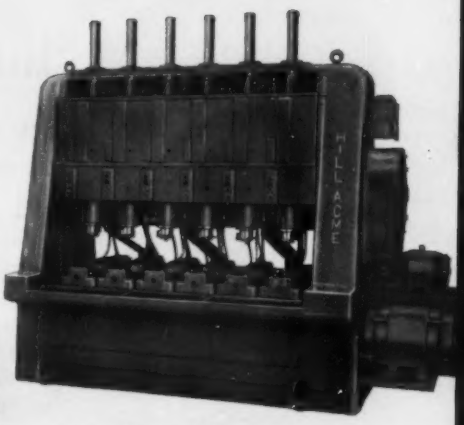
CIRCLE 324 READER SERVICE CARD

CIRCLE 325 READER SERVICE CARD ▶

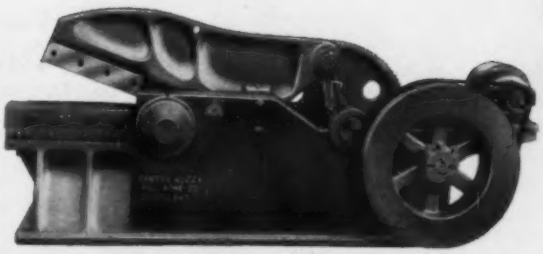
Tools for Industry



BAR-BILLET SHEARS
Modern, efficient design. Made in 3" to 6½" sizes. Choice of hand, semi-automatic or fully automatic feed. Assures clean, square cuts with low maintenance.

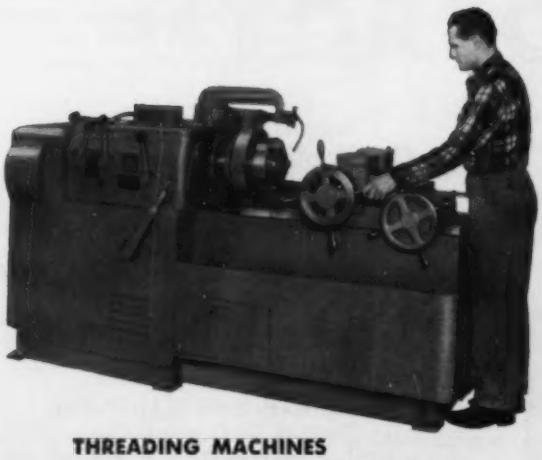


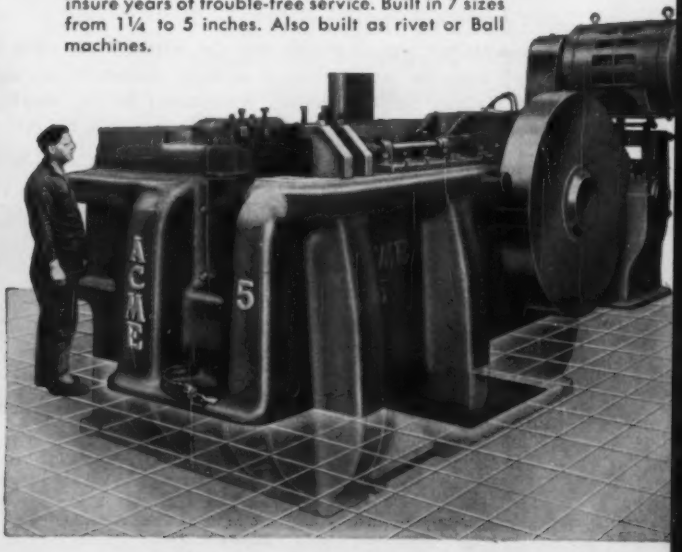
ALLIGATOR SHEARS
"CANTON" Alligator Shears are the most rugged, powerful and trouble free shears ever built for processing scrap. Modern design has produced a stronger shear, with fewer parts, and positive lubrication. Made in a full range of sizes to meet every condition.



TAPPING MACHINES
"ACME" model XC-W six spindle Coupling Tapper. Built in 1" capacity and larger, in 6 or 8 spindle. Can be adapted as a nut tapper.

FORGING MACHINES
"ACME" XN Forging Machines produce accurate, quality forgings for long uninterrupted periods. Massive construction and simplicity of operation insure years of trouble-free service. Built in 7 sizes from 1¼ to 5 inches. Also built as rivet or Ball machines.





THREADING MACHINES
"ACME" HA Single and Double Spindle Threading Machines are equipped with tangent or hob type die head which assures economical, accurate, high speed production. Furnished in sizes from 1" to 2½" capacity.

THE HILL ACME COMPANY

1201 WEST 65th STREET • • • CLEVELAND 2, OHIO

"HILL" GRINDING & POLISHING MACHINES • HYDRAULIC SURFACE GRINDERS • ALSO MANUFACTURERS OF "ACME" FORGING THREADING • TAPPING MACHINES • "CANTON" ALLIGATOR SHEARS • BILLET SHEARS • "CLEVELAND" KNIVES • SHEAR BLADES

Ordinary spring and Strippit Hydra-Spring of equivalent force.

equal stripping power in 1/6 the space

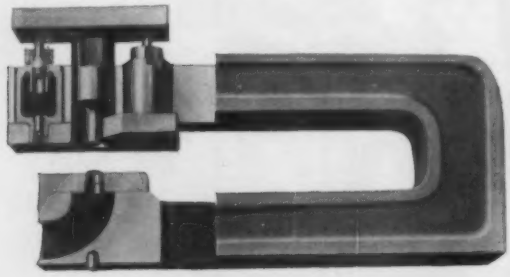
to cut your heavy-duty tooling costs!

Where high stripping pressures are required due to size and type of work or thickness of stock, Strippit Hydra-Springs are the answer. Utilizing the compressibility of liquids, Hydra-Springs develop up to six times the force of equivalent mechanical springs, greatly reducing the number, travel and size of stripping units required.

Impressive economies through Strippit flexible multiple-unit press setups

Like the Strippit, the Hydra-Spring is used in the Strippit line of independent, self-contained, self-stripping punching units. This is the tooling system that breaks the time and cost barriers of fixed perforating dies by permitting simple bench assembly setups . . . all but eliminating press down-time whether it's a long production run, a pilot run for design changes or a "repeat" run later on. No burring necessary, of course.

WHATEVER YOUR PIERCING OR NOTCHING APPLICATION, don't miss the major savings so many industries are enjoying with flexible Strippit tooling. Write today for full details, and if you wish, a demonstration at your plant by a mobile Strippit unit.



Using Hydra-Springs for the heaviest duty work, the Strippit line of hole punching units offers a complete range of capacities up to ¾" in mild steel. A full stock of quick-change standard tools or "specials" made to your order. Warehouse stocks in Chicago and Los Angeles.

WALES STRIPPIT COMPANY
200 Buell Road • Akron, New York

UNIT OF HOUDAILLE INDUSTRIES, INC.

Manufactured in Canada by Strippit Tool and Machine Limited, Brampton, Ontario

Field Report . . .

Bullpup Contract for Martin

The Martin Co's Orlando, Fla, facility has been awarded a $2.4-million contract to produce the Bullpup guided missile. Martin carried out the original R & D work on the Bullpup, which is used by carrier-based Navy planes and shore-based Marine aircraft.

Boeing and the Minuteman

Three Boeing groups will have a hand in assembling and testing the new Minuteman missile—Systems Management Office, Pilotless Aircraft Division, and the Seattle Division. SMO will handle the management end, Seattle Division will assemble the missile and housing for the test equipment, and PAD will field test it at Cape Canaveral, Fla.

Titan Contract to Beckman

Beckman Instruments Inc has received a contract from The Martin Co, Denver, for precision power monitoring equipment to be used in testing the Air Force's Titan ICBM.

Big Boy Spreads Out

Big Boy Mfg Co, Burbank, Calif, has acquired an additional facility in St Louis as part of a three-year expansion program. Move is designed to allow faster distribution of the firm's home barbecue equipment, and it is expected the first units will come off the lines this week.

Biggest Aluminum Furniture Plant?

Lawnlite Co, Miami producer of aluminum casual furniture, is building what it claims will be the "world's largest aluminum furniture factory" (cost $2.5 million, 400,000 sq ft) in the Hialeah section of Miami. Plant will double Lawnlite's present $10-million-a-year production.

Hufford Gets Nike Order

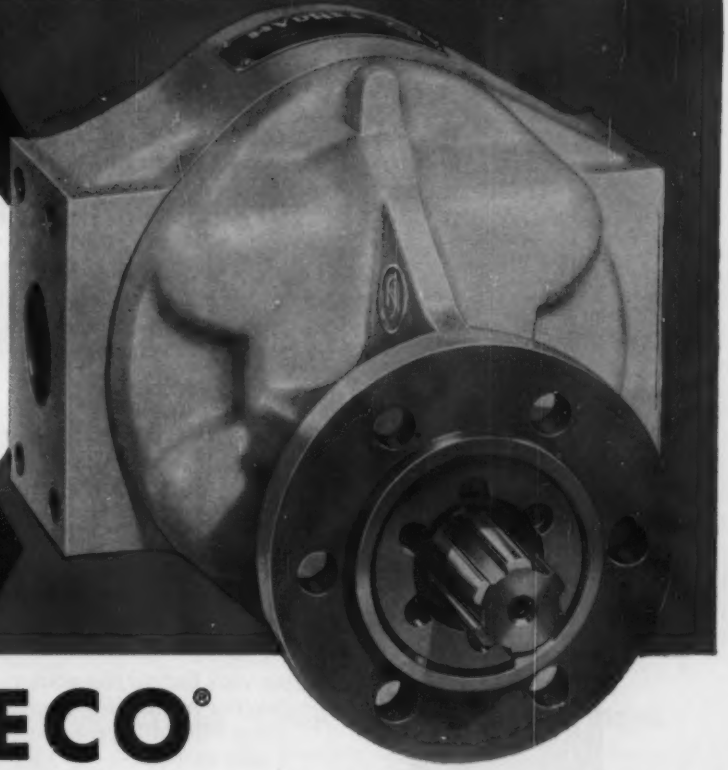
Hufford Division of Siegler Corp has been awarded a $350,000 contract to manufacture Nike missile system hydraulic test stands from Douglas Aircraft, which had previously been awarded a $5.6 million Army Ordnance contract for Nike adaptation kits and related items.

Anaconda in Georgia

Anaconda Wire & Cable Co's Watkinsville, Ga, plant, which initially employs about 100 people, has started production.

(Continued on page 304)

NEW HIGH PRESSURE FLUID POWER FOR MOBILE EQUIPMENT . . . .



DESIGNERS . . .

Investigate the Advantages of Low Cost, Long Service Life and High Pressure Operation on Mobile Equipment!

HYDRECO®

Series 2100 GEAR PUMPS

16 to 32 gpm at 1800 rpm
Operating Pressures to 2000 psi
40 gpm at 1800 rpm
Operating pressures to 1500 psi

Designed to cover a broad range of difficult applications, such as: heavy duty earth moving, road building and materials handling equipment. They feature four design advances that add up to . . . *More Duty Hours at Top Volumetric Efficiency and Minimum Cost.*

- Piloted housing and end covers eliminate shifting.
- Thrust bearing—to take axial thrust of hydraulic forces.
- Two-stage seal—runs cooler—lasts longer.
- Improved shaft bearings—tolerate increased loading.

The 2100 Series of HYDRECO Gear Pumps embraces heavy duty applications in the range immediately below that covered by the famous HYDRECO 3000K Series. Thus, with the 2100 and 3000K Series engineers have a broad selection of sizes in Hydraulic Pumps with established history of high performance and dependability.

Member NFPA

Write— for full information on Series 2100 and Series 3000K Gear Pumps.

HYDRECO Division
The New York Air Brake Company
9001-11 E. Michigan
Kalamazoo, Mich.

Please send me latest bulletins on HYDRECO Series 2100 and Series 3000K Hydraulic Pumps.

Name_____

Company_____

Address_____

City_____ Zone____ State_____

HYDRECO DIVISION
THE NEW YORK AIR BRAKE COMPANY
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NOW ... for keeness of vision to match skill of hands

MITI-MITE®
magnetic-base
MAGNIFIER
by
LUFKIN

Here's a magnifier that clings *magnetically* to any ferrous work surface. It banishes errors in reading fine graduations. It eliminates eyestrain.

Five-power lens swivels 360 degrees. Useful, too, on many tools that have fine graduations, such as mikes, vernier height gages, etc.

See your Lufkin Distributor. Ask him to show you the whole line of Miti-Mite precision measuring tools.

Always buy from your distributor

Rule No. 2306 graduated to 50ths

No. 124 ACTUAL SIZE

THE LUFKIN RULE COMPANY
TAPES • RULES • PRECISION TOOLS
SAGINAW, MICH. • MIDDLETOWN, N.Y. • BARRIE, ONT.

Field Report . . .

Anderson Electric Co Expands

The electrical connector manufacturer, now headquartered in Birmingham, Ala, is adding 40,000 sq ft to its Leeds, Ala, plant. Expansion is another step in Anderson's plan to move its entire operation to Leeds. Its aluminum plant is in Leeds; executive offices, bronze foundry, and machine shops are in Birmingham.

4½ Million Parts . . .

. . . are stocked at the new seven-acre Central Parts Division warehouse recently opened by Clark Equipment Co at 7300 S Cicero Ave, Chicago. Items range from oil line seals weighing less than an ounce to two-ton transmissions. Electronic and integrated data processing equipment speeds delivery.

Telecomputing Corp . . .

. . . has an add-on contract in excess of $1.5 million from Army Ordnance for nuclear warhead test equipment. This brings the Los Angeles firm's total volume of business on this program to more than $5.5 million.

Spokane Pump & Pipe Co . . .

. . . has brought Spokane Manufacturing Co, machine tool and punch press firm, and will transfer its headquarters to SM's plant on the northeast side of the city.

Ace Industries Contract

The nuclear Products-Erco Division of Ace, located at Riverdale, Md, has a $2.3 million AF contract for design and construction of electronic flight training devices that simulate the performance of the supersonic F-105 jet fighter.

Genco Tool & Engineering Co . . .

. . . Bethesda, Md, is set to open a tool and die manufacturing company at Athens, Ala.

Pacific Far East Line, Inc . . .

. . . San Francisco, has signed a 20-year subsidy contract with Federal Maritime Board that calls for construction of nine ships before 1974 at a cost of $131 million. Bid invitations for construction of first two Mariner-class vessels will go out next spring. These will be conventional type, but consideration will be given to nuclear power for subsequent ships. PFE operates freight service between California and the Far East.

Free Literature

To order any of these bulletins, circle corresponding number inside back cover.

MACHINES AND ATTACHMENTS

1 HORIZONTAL PRESSES — *Dake Corp, Robbins Rd, Grand Haven, Mich.* 8-page illustrated catalog 410 gives details on line that includes types for handling extra long or extra heavy work. Units are available with both single action and double action rams and fixed or movable head and table channels; furnished with hand, air, or electrically operated hydraulic pumps; capacities range from 25 to 600 tons.

2 AUTOMATIC TURRET LATHES— *Jones & Lamson Machine Co, Springfield, Vt.* 8-page bulletin LO-5808 contains illustrated information on ram-type automatic units with Lynn hydraulic drives. Specifications given for five models; design and operating features pictured and described.

3 C-FRAME PRESSES — *Hydraulic Press Mfg Co, Mount Gilead, Ohio.* 8-page catalog 58CPM illustrates and describes function and operating characteristics of two new manually controlled units. 12-page bulletin 58CPA covers four new automatic models. Accessories include a 6, 8, or 12-station index table. Dimensional and application data included in both catalogs.

4 ELECTROLYTIC METAL REMOVAL — *Standard Electrical Tool Co, 2488-96 River Rd, Cincinnati 4, Ohio.* Booklet discusses process which is based on anodic dissolution. Tool or workpiece to be shaped becomes the anode; grinding wheel becomes a rotating cathode and is mounted on a specially designed spindle and insulated from the machine body. Data sheets included in the catalog give details on Standard's Super Precision Spindles, an integral element of the equipment required for the process.

5 PLAIN CYLINDRICAL GRINDER— *Landis Tool Co, Waynesboro, Penna.* 4-page bulletin CD-58 presents detailed information on the 10-in. Type DCH and 14-in. Type LDCH. Applications illustrated; standard and extra equipment listed; specifications included.

6 BED-TYPE MILLING MACHINE — *Producto Machine Co, 990 Housatonic Ave, Bridgeport 1, Conn.* Illustrated 4-page bulletin describes new No. 1 for light and medium production work. Unit is available in three standard arrangements, with hydraulic or manual feed, and work surfaces

(Continued on page 308)

"I hate sounding like a wife, Dewitt, but I wish you'd pick up and be a little neater around here."

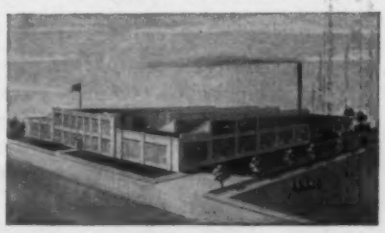
Here's how CDT can help you

CDT CAN INCREASE YOUR PRODUCTION
. . . because CDT specializes in designing and building tools and machines for today's high production demands.

CDT CAN IMPROVE YOUR QUALITY
. . . because CDT tools, jigs, fixtures and machines are precision engineered and built to the strictest requirements.

CDT CAN LOWER YOUR PRODUCTION COSTS
. . . by increasing the efficiency of your operation with special tools that do the job better—faster—more economically.

Call on Columbus Die-Tool for your special tooling problems. A large creative engineering staff with experience in developing special tools and machines for hundreds of industries is at your service. Over 50,000 square feet filled with precision production equipment enables us to build fine tools and special purpose machines to exacting requirements. Avail yourself of the industry-wide experience of Columbus Die-Tool.



FREE: *New brochure listing facilities, equipment, etc. Write today.*

Columbus Die-Tool
AND MACHINE COMPANY
P.O. BOX 750 • COLUMBUS, OHIO
ESTABLISHED 1906

Designers and manufacturers of JIGS • FIXTURES • SPECIAL TOOLS • UNITS FOR MACHINE TOOLS • *also Builders of Machine Tools Complete*

CIRCLE 329 READER SERVICE CARD

RICHARD F. MOORE, President
Moore Special Tool Co., Inc.

a man who came to Fair Street

"Like everyone else we had to see the Jigmil Technique before we could believe it"

"Our visit to Fair Street resulted in the purchase of three JIGMILS. The machines are part of a complete retooling program to help us meet rising costs and hold the line on our prices. We use the JIGMILS to machine larger jig borer and jig grinder parts to the fine accuracies required in our own machine tool products. We do not believe that we could design and build a special machine for our own needs that would beat the JIGMIL. For us, the JIGMIL is the last word."

RICHARD F. MOORE

DE VLIEG MACHINE COMPANY, FAIR STREET • ROYAL OAK, MICHIGAN

CIRCLE 330 READER SERVICE CARD

SOME OF OUR JIGMIL USERS

American Steel Foundries
Avey Drilling Machine Co.
Axelson Manufacturing Co.
Baldwin-Lima-Hamilton Corp.
Barber-Colman Company
Blanchard Machine Co.
E. W. Bliss Co.
Boyar-Schultz Corp.
Brown & Sharpe Mfg. Co.
Bryant Chucking Grinder Co.
Buhr Machine Tool Co.
Cincinnati Milling Machine Co.
Cincinnati Shaper Co.
Cleveland Automatic Machine Co.
Cone Automatic Machine Co., Inc.
Crankshaft Machine Co.
Cross Company
Davis & Thompson Co.
Detroit Broach Company
Ex-Cell-O Corporation
Foote-Burt Company
Gisholt Machine Co.
George Gorton Machine Co.
Gould & Eberhardt, Inc.
Greenlee Bros. & Co.
Heald Machine Company

ADVANTAGES OF THE JIGMIL TECHNIQUE
reported by Moore Special Tool Co., Inc.

- Fast, fool-proof positioning
- Quick tool changes
- Fast indexing of part to four sides
- Retraction of table for measuring
- Depth of hole stops
- Quick change of wide spindle speed range
- Large range of boring bars from DeVlieg stock
- Easy accessibility to controls

ACCURACY IS AN ECONOMY!

JIGMIL—THE MACHINE TOOL BUILDERS' MACHINE TOOL

Moore uses its three JIGMILS with DeVlieg Microbore boring bars to mill, bore, drill and tap large components for its own line of ultra precision machine tools. A jig grinder spindle housing is shown being machined on their 2B-36 JIGMIL equipped with a DeVlieg 20" x 20" index table. Parts are rough and finish machined to precise limits of accuracy on four sides in one setting by simply indexing the index table.

Ingersoll Milling Machine Co.
Jones & Lamson Machine Co.
Kearney & Trecker Corp.
Landis Tool Co.
R. K. LeBlond Machine Tool Co.
Lees-Bradner Company
Lodge & Shipley Company
Mechanical Specialties Co.
Moore Special Tool Co., Inc.
National Automatic Tool Co., Inc.
National Machinery Co.
Onsrud Machine Works
Rockford Machine Tool Co.
Snyder Tool and Engineering Co.
Sundstrand Machine Tool Co.
Warner & Swasey Company

WILL YOU BE THE NEXT TO VISIT FAIR STREET

Our newest catalog will help you decide. May we send it?

DeVlieg

SPIRAMATIC JIGMILS®

ACCURATE HOLES AND FLAT SURFACES IN PRECISE LOCATIONS

CIRCLE 331 READER SERVICE CARD

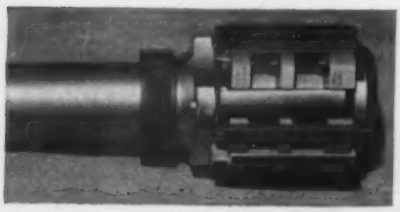
WHY MICROHONING* TOOLS ASSURE

ECONOMY — PRECISION — PRODUCTION

COST FACTORS (labor, maintenance, scrapped parts, productivity, etc.) DETERMINE MACHINE TOOL EFFICIENCY.

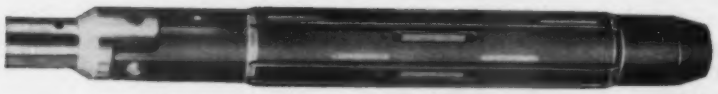
To Minimize These Cost Factors, Micromatic has developed Microhoning tools that offer a new concept in metalworking. This concept (known as the Microhoning process) assures controlled abrading, efficient stock removal, accurate generation of geometry and size, and produces uniform, functional surface finishes.

Because Microhoning removes inaccuracies of preceding operations, it is usually the final stock removal operation. Therefore, Microhoning tools are designed and applied to produce high precision, assure a minimum of scrap and protect the user's investment in previous processing operations.



New! Tru-Float tool has a universal joint within the abrading unit. This design provides maximum accuracy and float, uniform abrading and surface finish, less wear of abrasives, retention of original bore location, and minimum stock removal to correct inaccuracies.

Micromold assemblies have plastic or soft metal shells that minimize tool wear and protect the edges of abrasive sticks from the harsh dressing action of extremely rough bores. This abrasive stick design eliminates many parts previously required to hold abrasives and expand the tool.



Tool designed for Microhoning tandem bores has plastic guides between banks of abrasives to stabilize the tool as it passes over bore interruptions.

Because use of the proper tool is so important, Micromatic designs Microhoning tools to suit the individual work piece, and integrates tool design with machine and fixturing to provide the ultimate in operating efficiency.

*Registered U.S. Pat. Off.

MICROMATIC HONE CORP.

8100 SCHOOLCRAFT AVENUE · DETROIT 38, MICHIGAN

Free Literature

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of different dimensions for small lot production work, longer production runs, and low production and toolroom work.

7 AUTOMATIC TURRET DRILLS — *Burg Tool Mfg Co, 15001 S Figueroa St, Gardena, Calif.* 12-page bulletin illustrates and describes 6 and 8-spindle hydraulic units, and Burgmaster 6 and 8-spindle tape-controlled models and machine accessories. Details given on how the hydraulic machines are set up for operation, including pre-selected speed changes, depth control, and feed rate, for each spindle. Drilling and tapping capacities, ¾ in. and 1½-in. dia in steel.

8 ROTARY SURFACE GRINDER — *Heald Machine Co, 4 New Bond St, Worcester 6, Mass.* 8-page illustrated bulletin 2-161-1 contains information on Model 161 for precision grinding of flat, concave, and convex surfaces of small work. Column-design machine has a 6-in. magnetic chuck, 10-in. vertical capacity to center of wheel, 4-in. grinding stroke, and 12½-in. swing inside of guard.

9 GAP - FRAME STRAIGHTENING PRESSES—*Williams-White & Co, Moline, Wis.* 8-page illustrated form 78 gives data on hydraulic units from 25 to 200 tons in capacity, with specifications. Variety of models shown, as well as tools and fixtures, and controls.

10 PRINTED CIRCUIT DRILLING — *Zagar, Inc, 24000 Lakeland Blvd, Cleveland 23, Ohio.* 6-page bulletin 858 illustrates and describes variety of heads for mounting on air-oil feed drillpresses. Applications and equipment requirements described.

TOOLS AND ACCESSORIES

11 GUILLOTINE HYDRAULIC CUTTING TOOLS—*Manco Mfg Co, Bradley, Ill.* 70-page spiral-bound illustrated catalog 158 on special purpose high thrust hydraulic cutting tools is divided into nine sections, according to general types of material to be cut, such as wire and rod, steel billet, strip, bar, tubing. Sections are included on fabricating, auxiliary power equipment, accessories. Thrust data charts for punching and riveting, as well as recommendation charts for cutting of mild, high carbon, and alloy steel rods are included.

12 PRECISION GAGES AND TOOLS— *Engis Equipment Co, 431 S Dearborn St. Chicago 5, Ill.* 12-page catalog contains illustrated, condensed descriptions of optical, electronic, and mechanical devices—tools, gages, instruments—all simply indexed for immediate reference.

"I'm sorry I can't answer that question, gentlemen—it's top secret. Only a few top scientists, the Secretary of War, the President and the Russians know it."

13 DIAMOND TOOLS—*New York Diamond Tool Co, 380 Glenwood Ave, East Orange, NJ.* Illustrated catalog covers most widely used types. Contains data on care and use; guide to selection of diamond sizes. Additional information sheets for insertion in this binder will be available from time to time.

14 LUBRICANTS—*Sun Oil Co, Industrial Products Dept, 1608 Walnut St, Philadelphia 3, Penna.* Booklet gives information on complete line of products including general and specialty lubricants; greases; cutting, quenching, and other metalworking oils; hydraulic oils; waxes; spray oils; solvents.

15 UNIVERSAL ANGLE VISE—*Wesson Co, 1220 Woodward Heights Blvd, Ferndale 20, Mich.* Illustrated brochure AV-158 covers precision Model 1A, plus specifications on complete line of angle vises and angle plates. Wide range of applications pictured.

16 CHUCKS—*Supreme Products Corp, 2222 S Calumet Ave, Chicago 16.* 14-page catalog gives mechanical features and specifications on each of the 50 models. Also covered are chuck keys, arbors, chuck repair parts, and line of portable drill attachments.

17 VISE—*R S Wilder, Inc, 26 Bedford St, Waltham 54, Mass.* Bulletin illustrates and describes features and applications of the All-Shapes vise designed to hold odd, unusual shapes that formerly required special jigs or fixtures. Capacity is 3-in. face, 3-in. opening.

18 MINIATURE DRILLS, REAMERS, END MILLS—*Super Tool Co, 21650 Hoover Rd, Detroit 13, Mich.* 8-page catalog SB-302 contains tabular data on new solid cemented carbide units in sizes as small as 0.024-in. dia. Specifications, applications, prices. Tools listed are for nonferrous metals, plastics, non-metallic materials. Separate listing is included on hard steel drills for drilling hardened steels.

HEAT TREATING AND WELDING

19 GAS WELDING AND CUTTING EQUIPMENT—*Harris Calorific Co, 5501 Cass Ave, Cleveland 2, Ohio.* 32-page catalog 586 (plus 8 pages of pricing information) illustrates and describes welding torches and tips, cutting torches and tips, regulators, and welding and cutting accessories.

20 ELECTRIC FURNACES AND OVENS—*L & L Manufacturing Co, 136 Eighth St, Upland 79, Del Co, Penna.* Literature contains brief, illustrated descriptions of variety of heating, treating, processing, production and lab furnaces, and two series of forced convection ovens for lab and production use.

21 ULTRASONIC FLUXLESS SOLDERING—*Aeroprojects Inc, Box 555, West Chester, Penna.* 8-page illustrated bulletin SB-5 provides information on Sonosolder equipment and applications. Models range from a hand unit to a specialized high-production unit, with special tips made to suit individual needs. Equipment is used for fluxless soldering of silicon, germanium, aluminum, magnesium, and many other materials.

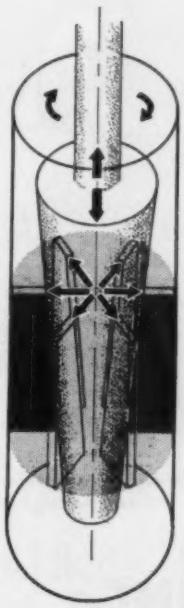
● ELECTRONIC WELDING EQUIPMENT—*Vacuum Tube Products Co, 2020 Short St, Oceanside, Calif.* Illustrated short-form catalog describes line designed to join light-gage materials ranging from 0.0003 to 0.080 in. Includes cabinet welders, bench welders, and accessories. Request direct on company letterhead.

22 SEAM WELDER—*Sciaky Bros, Inc, 4915 W 67th St, Chicago, Ill.* 6-page bulletin 316-7 contains data on Type MP 1 air-operated, press-type, single-phase unit. Machine data is tabulated to indicate kva

HOW MICROHONING* TOOLS PROVIDE

ECONOMY — PRECISION — PRODUCTION

When a precision stock removal process minimizes cost factors (labor, maintenance, scrapped parts, etc.) then volume production at lower cost per piece is possible. Here's how the distinctive design and performance of Microhoning tools provide all three—economy, precision and production.



EFFICIENT OPERATION

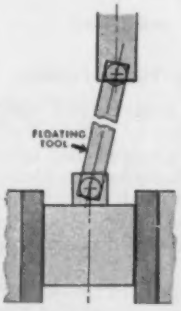
Micromatic expands, rotates and reciprocates the abrading tool in the bore. Through this controlled combination of pressure and movements, abrasives are self-dressing for effective and continuous cutting action. Long abrasive sticks are evenly spaced around the tool to keep it stable. They effectively bridge surface irregularities and generate a geometrically true cylinder.

REDUCES OPERATOR COSTS

Micromatic. "Adjusting Heads" give operator complete and positive control of tool expansion. Or, automatic controls can be used to perform all tool adjustment and gaging. They assure accurate duplication in every part produced.

MINIMUM MAINTENANCE

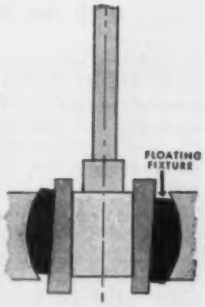
Micromatic tools are designed for durability, especially at all stress points and joints. Plastic or soft metal holders prolong abrasive life, greatly reduce tool wear.



MAINTAINS ORIGINAL BORE LOCATION

Micromatic either floats the tool or the work holding fixture so tool and work piece can automatically align themselves. This assures cutting-unit rotation coincides with neutral axis of bore.

WRITE FOR LITERATURE



Micromatic produces tools best suited to the production of individual work pieces. And properly integrates the tool with machine and fixturing for peak productivity at lowest cost per piece produced.

*Registered U.S. Pat. Off.

MICROMATIC HONE CORP.

8100 SCHOOLCRAFT AVENUE · DETROIT 38, MICHIGAN

CIRCLE 333 READER SERVICE CARD

Roll out the ROTORS

BG8-HT Rotor Grinder
with Automatic Loading Fixture.

...FIRST in Abrasive Belt Grinding—
gives you mass production and quality control in

ROTOR GRINDING

with the New BG8-HT ROTOR GRINDING MACHINE

Completely automatic, the new Engelberg Model BG8-HT requires no manual operation. Rotors are automatically fed, precision sized and discharged in production quantities in a continuous cycle. Saves time, cuts rejects.

Check these production examples of the BG8-HT: 3⅜" O.D.; 2-up; 180 per hour (.030 stock removal from 2" stack.) 1-9/32" O.D.; 6-up; 1,440 per hour (.010 stock removal from ⅞" stack.)

Engelberg Model BG8-HT Features

★ Holds ± .001 diameter and within .0005 concentricity.

★ Hydraulically actuated feed movements, including table feed, oscillation, regulating wheel and belt tensioning.

★ Variable regulating wheel speeds to accommodate 1 to 4½" diameter range of rotors.

★ Automatic air-electric device provides constant in-process gauging, guaranteeing precision size control.

WRITE FOR MORE INFORMATION ABOUT THE ENGELBERG ROTOR GRINDING MACHINE

ENGELBERG, INC.

Precision ABRASIVE BELT GRINDERS

186 SENECA STREET • SYRACUSE, N.Y.

Free Literature

To order any of these bulletins, circle corresponding number inside back cover.

range, throat depths, welding capacities. Mash Welding, a resistance seam welding technique used to fasten the edges of a smooth weld with the near thickness of one sheet, is illustrated and described.

PLANT SERVICE EQUIPMENT

23 "PALLET HANDLING IN NARROW AISLES" — *Raymond Corp, 47-170 Madison St, Greene, NY.* 24-page handbook describes principal types of trucks available for narrow aisle operations, shows on-the-job pictures of equipment in use. Specifications, design features included.

24 BARREL FINISHING MACHINES —*Wheelabrator Corp, Techline Div, 1140 Ave V, Vicksburg, Mich.* Illustrated bulletin 201 provides information on multiple-compartment units available in wide range of styles with standard components and sub-assemblies.

25 MANIFOLD DISTRIBUTION SYSTEMS—*National Cylinder Gas Div, Chemetron Corp, 840 N Michigan Ave, Chicago 11, Ill.* 28-page brochure N 125 discusses production, space, and cost benefits in continuous distribution of industrial gases through custom-built installations. Duplex, simplex, and portable systems piping oxygen, hydrogen, nitrogen, helium, argon, acetylene, and other gases for uses such as welding, cutting, heating, flame hardening, flame blasting, and oxygen lance operations are detailed.

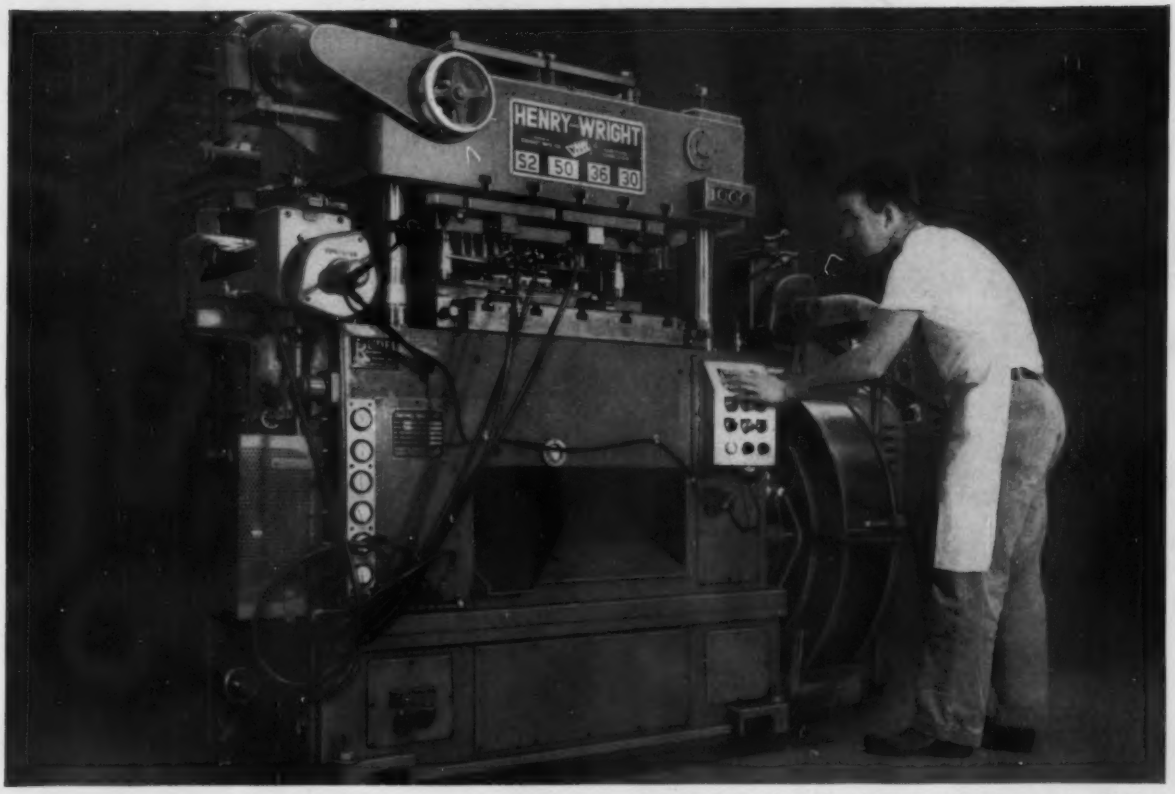
26 FORK LIFT TRUCK—*Allis-Chalmers Mfg Co, Milwaukee, Wis.* 8-page catalog BU-485 gives information on engineering, design, and construction of the FT20-24, a 2000-lb-capacity unit. Illustrations, specifications, and charts supplement description of features of new 35-hp model.

27 STORAGE EQUIPMENT — *Pesco Products Div, Automatic Warehousing Branch, Borg-Warner Corp, Bedford, Ohio.* 4-page brochure presents illustrated description of fully automatic warehouse which doubles use of existing space and reduces manpower output. Outlines how system offers max cube space utilization, consistent automatic handling, and max service with minimum maintenance. Controls, systems, and consoles used in the

(continued on page 314)

". . . I suppose it will be the same old story— I'll just get you trained and you'll up and get married to one of our handsome executives and quit. . ."

Another Outstanding Henry and Wright Installation . . .



Henry & Wright 50-ton Double Crank at Electric Typewriter Division, International Business Machines Corporation, Kingston, N. Y.

IBM took these steps to assure quality stamping methods

Assure quality and reduce problems inherent in separate operations by using progressive dies for key components . . . design dies so as to accommodate sub-dies for variations in a part's configuration . . . build each die to the highest standards of precision . . . use presses of exceptional accuracy to assure maximum die life.

Double Crank Henry & Wrights were selected for this program. The pay-off: 180,000 type bars produced between die grinds as against half that number with old dies on conventional press; 8,000 trip levers per hour on a Henry & Wright against 5,000 per hour by the previous method.

Operational benefits cited by IBM personnel included: after a year's use, Henry & Wrights retained parallelism-alignment within .0005"; front and back accessibility of machines reduces die set-up time; misfeeding of stock eliminated; feed length variation is negligible, thereby making adjustments unnecessary to compensate for changes in press speed; punch clamping is easier.

To be sure of the maximum pay-off for improved methods in your plant, investigate Henry & Wrights. Catalogs are yours for the asking.

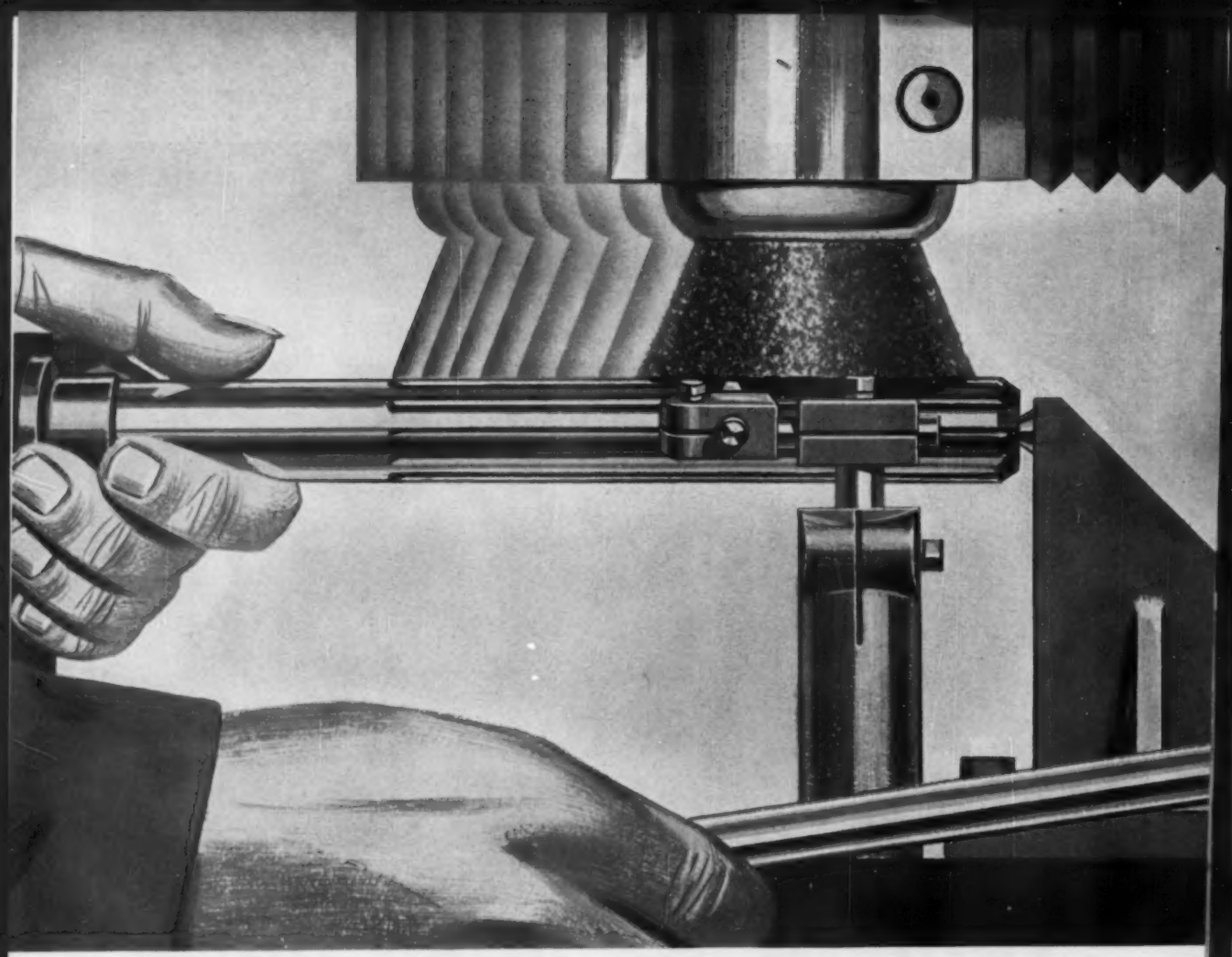
Now, more than ever before, there's an H-P-M for your particular job. Write today for complete information. Make H-P-M your standard for metalworking press equipment.

HPM

H802

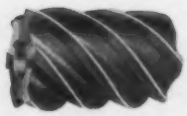
THE HYDRAULIC PRESS MFG. COMPANY

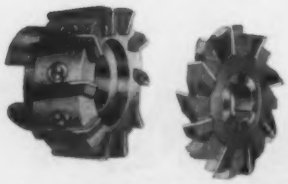
A DIVISION OF KOEHRING COMPANY • MOUNT GILEAD, OHIO, U.S.A.



Oliver "ACE" Tool and Cutter Grinder

WHEEL TRAVERSES... *not the work!*





Face mills, reamers, hobs, spot facers—all cutters straight or spiral —are quickly, easily and economically sharpened with the Oliver "Ace."

You can grind tools and cutters more accurately with the Oliver "ACE" because the wheel is brought *to the work*, reversing the usual process. Abrasive dirt and grit cannot cause wear because the cross carriage is not in motion. The horizontal ram which supports the grinding head moves in special bearings and is fully enclosed, sealed against dust and dirt. Further accuracy is assured because the wheel can be trued by a stationary diamond which provides a fixed grinding line. It is not necessary to reset the cutter to compensate for wheel wear.

The "ACE" is a universal tool grinder designed expressly for tool grinding—not a general purpose machine *adapted* to tool room work. It is simple to set up. All clearance angles are obtained by direct reading. Operators stand in a natural position with the control lever in easy reach and the work in direct view.

CIRCLE 336 READER SERVICE CARD

CIRCLE 337 READER SERVICE CARD ►

OLIVER Standard "ACE"

This machine is for high speed and light duty carbide grinding. Only two fixtures are required to handle a complete range of tool and cutter sharpening. Clearance angles are obtained by tilting the grinding wheel the desired amount as indicated on a scale graduated in degrees.

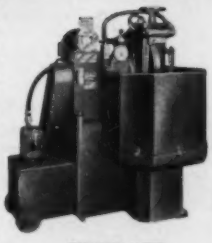
OLIVER Heavy-Duty "ACE"

. . . for grinding tungsten carbide cutters and tools in all of their many forms. Because it is for use with hard metals, all components have been designed with rugged going in mind. Like the standard "ACE," grinding is done on the top tooth, not on the side of the cutter. The operator has full vision at all times.

More OLIVER of ADRIAN Tool Grinding Equipment

FACE MILL GRINDER

Completely automatic. A machine tool designed for accurate grinding. Wheel dressed with every stroke.



TEMPLATE TOOL BIT GRINDER

Controlled form grinding for high speed, stellite and tungsten carbide single point tools.

No. 510 DRILL POINTER

Semi-automatic. For drills ¼" to 3" in diameter. No. 21 bench models available for size ½" and smaller.

DRILL POINT THINNER

For low cost reclaiming of drills. Corrects off-center and too-thick webs and out-of-index cutting edges.

DIE MAKING MACHINE

Produces dies, gages, cams, templates, stripper plates, etc. at greatly reduced costs. 5 designs in 2 types.

Just check the coupon for literature on the OLIVER of ADRIAN machine you are interested in. Send it today to . . .

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1414 E. Maumee St. • Adrian, Michigan

- ☐ Drill Pointer
- ☐ Face Mill Grinder
- ☐ "Ace" Universal Tool and Cutter Grinder
- ☐ Die Making Machine
- ☐ Drill Point Thinner
- ☐ Template Tool Bit Grinder

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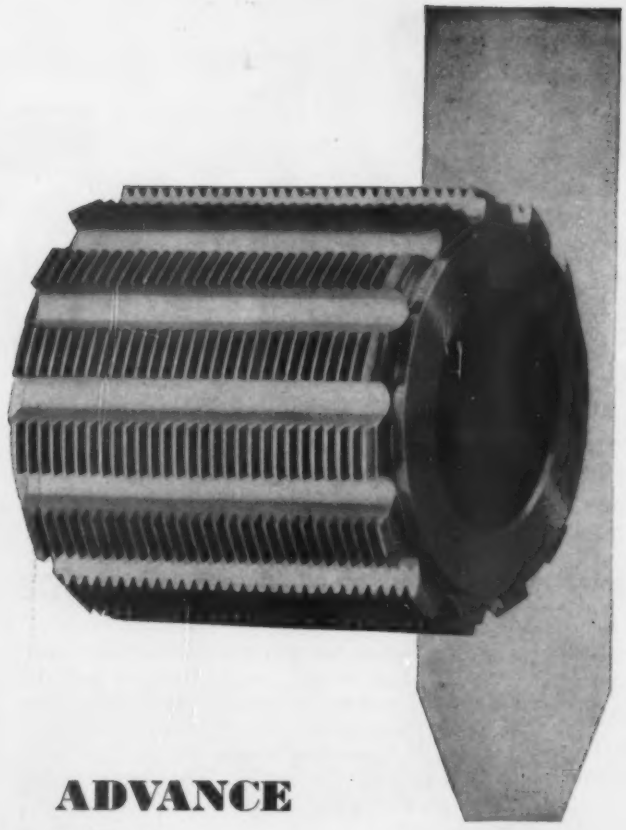

ADVANCE IN ACCURACY

Hanson-Whitney's refined accuracy standards for fine pitch ground thread gear hobs meet the most exacting demands of this highly specialized field.

A good example is outstanding *lead accuracy* . . . made possible by the exclusive H-W Process. This enables the operator, once the machine is set, to use the *entire* width of the gear hob *without resetting* . . . eliminates trial and error methods. And highest quality materials and heat treating insures maximum pieces per grind — more performance in dollar value.

Hanson-Whitney offers practical engineering assistance on all threading problems . . . provides a unified, **one source** supply for machine tools, cutting tools and precision gages.

And you can always count on Hanson-Whitney Distributors across the country for fast service from complete stocks.

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Hanson-Whitney COMPANY

Division of Whitney Chain Company

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HARTFORD 2, CONNECTICUT

TAPS • THREAD GAGES • HOBS • CENTERING MACHINES • THREAD MILLING MACHINES AND CUTTERS

Free Literature

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automatic control of picking, handling, scheduling, and inventory are illustrated; includes data on pallet adapters for all standard and special pallets.

28 DUST CONTROL—*Flexaust Co, 100 Park Ave, New York 17, NY.* 15-page bulletin 82 illustrates problems and suggests solutions for them; includes selection, pricing, and accessory information.

29 HYDRAULIC JET CLEANERS — *Sellers Injector Corp, 1600 Hamilton St, Philadelphia 30, Penna.* 8-page bulletin 424-B describes line of heavy-duty equipment for cleaning of walls, floors, or process equipment of all types; portable and stationary models covered.

30 ELECTROCLEANER FOR ZINC DIE CASTINGS—*Oakite Products, Inc, 124 Rector St, New York 6, NY.* Brochure F10466 provides information on Oakite Composition 195, a non-etching reverse current cleaner that removes soils without darkening or changing zinc color.

PARTS AND MATERIALS

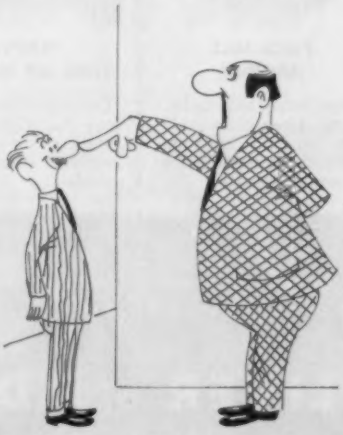
31 ADJUSTABLE SPEED DRIVES — *General Electric Co, Schenectady 5, NY.* 8-page bulletin GEA-6234B describes general-purpose Thymotrol drives, 1-hp half-wave and 1 to 4 hp full wave. Covers standard and optional features, electrical and performance characteristics, application advantages, and key construction features of the controller, dc motor, and operator's control station of the drives.

32 FIBER CARTRIDGE FILTERS — *Cuno Engineering Corp, South Vine St, Meriden, Conn.* 12-page catalog 53-101 contains information on Micro-Klean units for full flow filtration of all types of fluids. "Graded density" construction discussed; Selector Chart, cartridge life curve, flow rate table, and additional product performance data aid in proper selection; dimensions, illustrations, included for smallest to largest filter model series.

33 STRESSPROOF STEEL BARS—*La Salle Steel Co, PO Box 6300-A, Chicago 80, Ill.* 4-page bulletin discusses improvements in strength, machinability, and tolerances. Material has a 100,000-psi yield strength without heat treating, in all sizes.

34 FLEXIBLE HOSE ASSEMBLIES— *American Brass Co, American Metal Hose Div, Waterbury 20, Conn.* 16-page

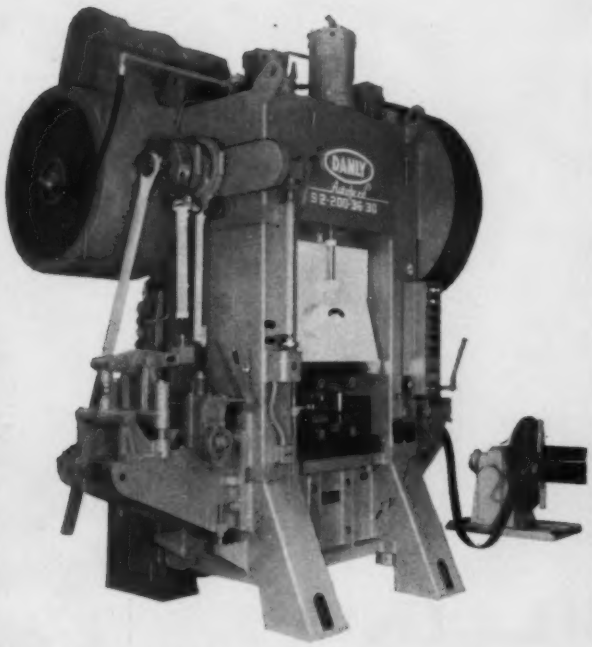
(continued on page 319)



"The only reason I'm keeping you around here Henderson, is that your stupid blunders keep me on my toes!"

The Leading Supplier to the Stamping Industry

in PRESSES

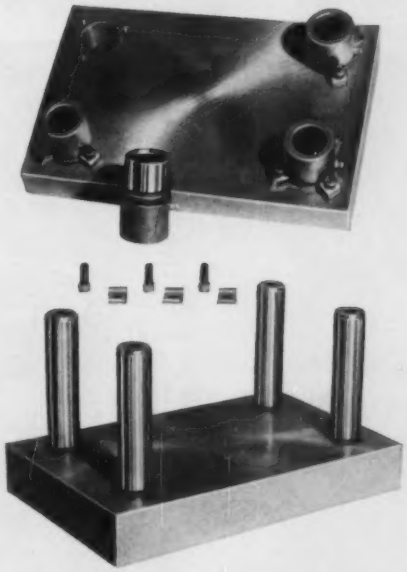


The report of the Business and Defense Service Administration shows that Danly led all producers of presses during 1957. Industry made Danly the first choice because you get lower operating costs with a Danly Press—you can depend on it! Each press is engineered to turn out more accurate stampings . . . to produce more units per shift . . . and to reduce profit-eating maintenance and spare parts inventories.

There are many new developments you should know about, such as the Quick Die Change feature available on all Straight Side Presses . . . single, double and triple action . . . the modern high-production Autofeeds . . . and the completely modern line of Open Back Inclinable presses just introduced. See how Danly can help you reduce costs and give your products the stamp of leadership!

Write for the new Autofeed Catalog that gives full information on Danly Presses for high-production stampings.

in DIE SETS and Die Makers' Supplies



The total production of Danly Die Sets during the past 20 years is *more* than enough to provide twelve dies for every mechanical press currently in use in the United States (based on American Machinist's Inventory of Metalworking Production Equipment).

In every instance, Danly can meet your most exacting diemaking specifications with a die set—standard or special. Since pioneering the first mass-produced precision die sets 36 years ago, Danly has continuously developed new production, inspection and distribution methods to serve you better.

Today, there's the new Danly Die Set with Demountable Bushings being assembled in a factory branch or distributor assembly plant near you. It is your fast, convenient source for toolroom and pressroom supplies that bear the stamp of leadership. Danly facilities for special Die Set manufacture are also improved and expanded .

Send for money-saving facts. Write us and your distributor or branch will give you helpful information on Danly Die Sets.

DANLY MACHINE SPECIALTIES, INC.

2100 S. Laramie Avenue, Chicago 50, Illinois

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PLANING + MILLING

of Heavy Workpieces in one set-up . . . on one machine

- Reduces machining time
- Reduces set-up time
- Increases over-all accuracy
- Cuts manufacturing costs

Write for details

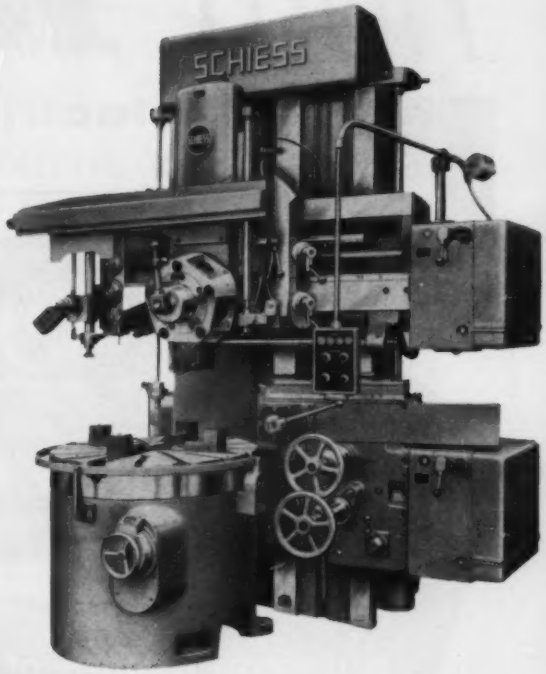
Waldrich Siegen combined planing and milling machines

WALDRICH SIEGEN

american waldrich mfg. corp.

1232 PENN AVENUE, PITTSBURGH 22, PENNSYLVANIA

Model KE Single Column Vertical Turret Lathes with 40", 50" and 65" turning diameters for high-speed carbide machining.



Hydraulic pre-selection of speeds set by handwheel and read on illuminated dial. 16 spindle speeds—ratio 1:50—up to 310 rpm for carbide machining on Model KE 100. Table runs on tapered roller bearings.

Fingertip control for direction of feed and rapid traverse with spring-loaded mono-levers for normal direction plus angular compound feeds. Mono-levers move in same direction as desired feed or traverse movement, simplify correct setting by operator. Specially designed electro-magnetic disc clutches disengage feed instantly with no over-riding or coasting.

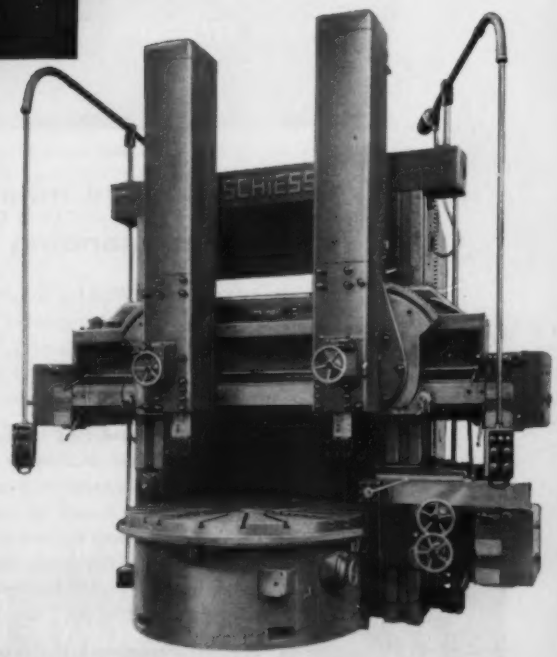
Counterbalanced cross rail and side head. Single lever unlocks, raises or lowers, and locks cross rail simultaneously by electro-mechanical controls. *No bolts or nuts to loosen or tighten by hand.*

Slip ring motor provides smooth "load sensitive" acceleration and braking. Variable speed as well as constant cutting speed available. Motor mounted on left side of machine with separate control enclosure. Fingertip control assured by pendant mounting of all necessary control functions. Electrics supplied from all U. S. manufacturers.

Copying attachment with electric tracer for use on cross rail or side head.

See why tool engineers call these heavy producers, "MOST MODERN MACHINES OF THEIR TYPE"

Model KZ Double Column Vertical Boring Mills with 65", 80", 98" and 118" turning diameters.



All operating features of KE Series Vertical Turret Lathes are combined in

SCHIESS KZ DOUBLE COLUMN VERTICAL BORING MILLS, PLUS—

Heads equipped with steel octagon rams can be swiveled—have automatic feed in vertical, horizontal and angular direction and are independent of one another as to amounts and direction of feed. Table, feed and rapid traverse controls are all contained in the pendant station. Standard model KZ Double Column Vertical Boring Mills are available with 65", 80", 98" and 118" turning diameters.

Get to know these products of Europe's largest builder of heavy machine tools. Parts and service are as close as Pittsburgh. An American Schiess engineer will be ready to help you size up these heavy producers for your heavy production needs. Write for catalogs and complete specifications on these and other Schiess equipment.

SCHIESS

AMERICAN SCHIESS CORPORATION

1232 Penn Avenue, Pittsburgh 22, Pa.

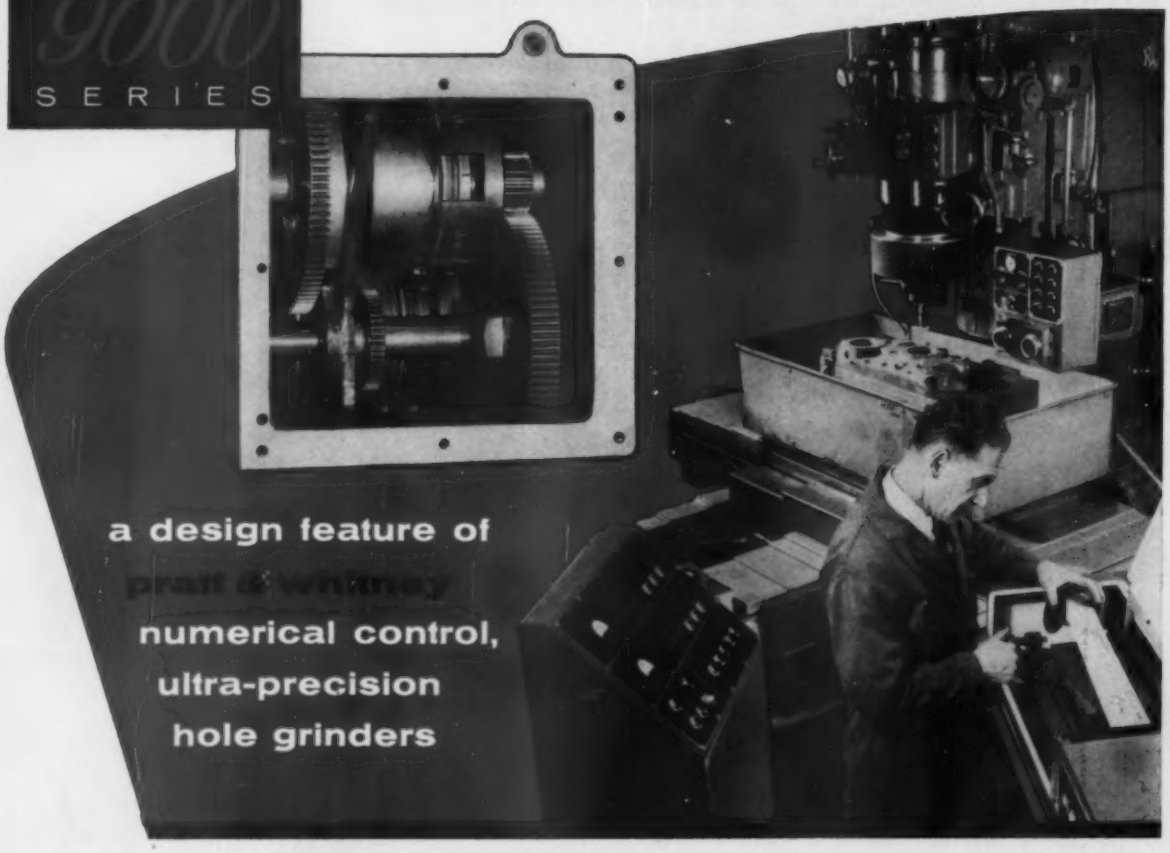
◀ CIRCLE 340 READER SERVICE CARD

CIRCLE 341 READER SERVICE CARD

new Maxitorq

electric clutches and brakes

9000 SERIES

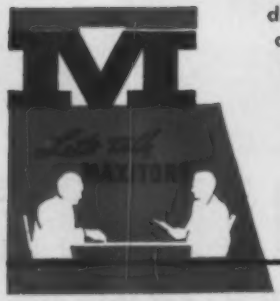


a design feature of pratt & whitney numerical control, ultra-precision hole grinders

Again a famous machine tool builder favors today's outstanding electric clutches and brakes

Previously, Pratt & Whitney incorporated MAXITORQ Clutches in their high-precision jig borers. Proved performance led their engineers to test and accept the new 9000 series MAXITORQ Electric Clutches for their latest development . . . the fully automatic, numerically controlled, ultra-precision Vertical Hole Grinder and Electrolimit Jig Borers. Inset photograph above shows the compact and "clean" installation of two of these clutches in the carriage control drive gear box.

Incorporating new and advanced design principles, the 9000 Series MAXITORQ Electric Clutch is well adapted to machine tool drives. It is simple in design . . . built to machine tool standards . . . requires no adjustments. It can be used *either as a clutch or brake*. Disc separators not only separate discs but also break up residual magnetism, and result in extremely fast, positive action with no drag or heating in neutral. Design principles have been PROVED through years of service. There are few moving parts. Electrical operating unit remains stationary—hence, there are no troublesome slip rings or brushes; no difficult wiring problems. Clutches operate on standard 110 V a.c. converted to 90 V d.c. Other voltages on special order.



If you have a clutch or brake application where you are looking for NEW and IMPROVED performance, we invite you to bring the problem to us.

Phone, wire or write Dept. AM-11 for new #9000 Series bulletin

The Carlyle Johnson Machine Company, Manchester, Conn.

Free Literature

To order any of these bulletins, circle corresponding number inside back cover.

illustrated bulletin TC-101 gives details on Teflon assemblies complete with end fittings for conveying such materials as searching liquids, chemicals, fuel, oxygen, steam, under conditions of temperature extremes, corrosion, high pressure.

35 CONTROL VALVES — *Conoflow Corp, 2100 Arch St, Philadelphia 3, Penna.* 12-page bulletin LB-3 presents illustrated description of complete line of Series LB that combines a single-seated valve body and cylinder actuator. Design and operational features, accessories, specifications and valve sizing data included.

36 COATINGS—*Bee Chemical Co, 12933 S Stony Island Ave, Chicago 33, Ill.* 36-page brochure contains information on clear and colored materials for use on metal, plastics, glass, and wood by spraying, screening, and roller-coating. Physical properties and applications for each. Data given on standard colors available including metallics, bronzeless gold, plus special coatings and effects.

37 LAMINATING EPOXY RESIN—*Rezolin, Inc, 1651 18th St, Santa Monica, Calif.* Bulletin RPD 900 provides information on Epolite 90 for tooling and equipment. Product is a one-resin laminating system, used for both surface coating and laminating, with formulated hardeners. Characteristics include higher flexural strength, lower cold creep, in shorter cure periods. Physical properties discussed, typical applications illustrated, step-by-step pictures and text outline proper method for use.

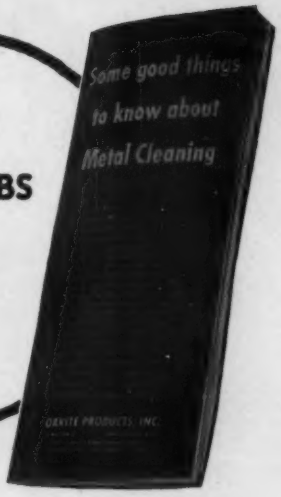
38 TOOL STEEL COMPARISON CHART—*Vulcan-Kidd Steel Div, H K Porter Co, Aliquippa, Penna.* 8½ x 11-in. chart covering carbon, alloy, and high-speed tool steel (AISI type) lists 43 brand names now being produced by the division. Includes main categories of tool steel; high speed, hot work, tool and die, shock and special purpose, plastic mold, and carbon and carbon vanadium.

39 SYNCHRONOUS MOTORS AND CONTROLS—*Westinghouse Electric Corp, Box 2099, Pittsburgh 30, Penna.* 27-page booklet B-7292, illustrated, contains motor selector charts, application data, and formulas for calculating power factor. In addition to summary of types and features of units, material includes discussion of power factor correction; factors to consider in selection; special application problems.

(Continued on page 322)

"J. B. wanted to have you shot but I've persuaded him to fire you instead."

WHICH METAL-CLEANING JOBS WOULD YOU LIKE TO IMPROVE?



¶ Are you cleaning metal in the most economical way? *See page 9 of Oakite's FREE booklet on Metal Cleaning.*

¶ Are you cleaning metal the fastest way? *See page 12.*

¶ Do you need room-temperature cleaning combined in one operation with temporary rustproofing? *See pages 12 and 14.*

¶ Do you know the advantages of alkaline pickling? *See page 21.*

¶ Have you compared the values of iron phosphate coating and zinc phosphate coating in preparation for painting? *See pages 22 and 25.*

¶ Can you use a cleaner that removes rust and oil at the same time; often eliminating all need for pickling? *See page 30.*

¶ Do you have trouble stripping epoxy resins, pigment residues, phosphate coatings and under-paint rust? *See page 31.*

¶ How do you clean parts that are too large to be soaked in tanks or sprayed in machines? *See page 31.*

¶ Are you getting full profit out of your finishing barrels? *See page 32.*

¶ What do you do when oversprayed paint neither floats nor sinks in your paint spray booth wash water? *See page 35.*

¶ Do you need better protection against rusting in process or in storage? *See page 37.*

FREE For your copy of *"Some good things to know about Metal Cleaning"* write to Oakite Products, Inc., 24 Rector Street, New York 6, N. Y.

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OAKITE
MATERIALS · METHODS · SERVICE
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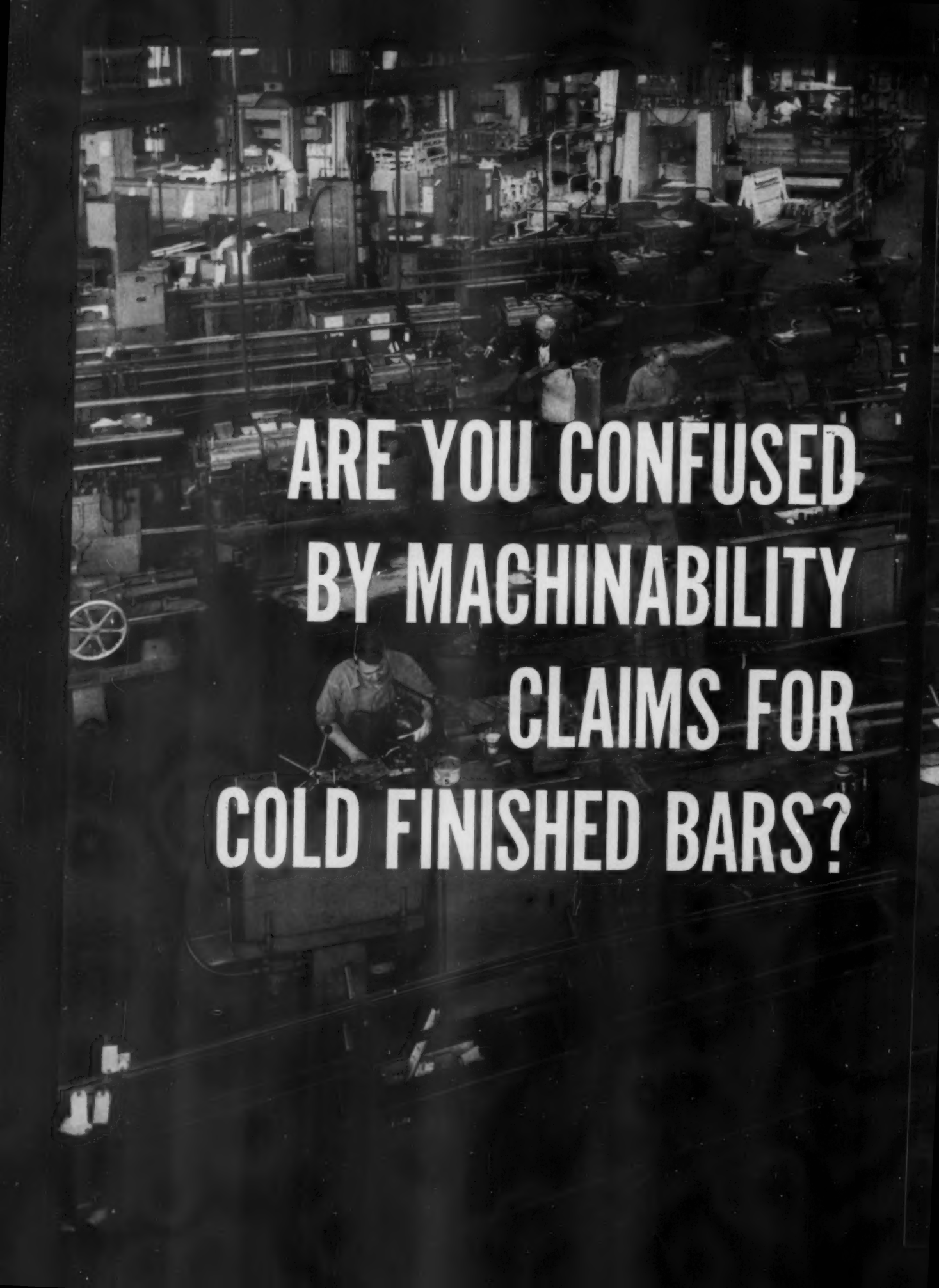

ARE YOU CONFUSED
BY MACHINABILITY
CLAIMS FOR
COLD FINISHED BARS?

What Are the Facts About Machinability?

Conflicting claims unfortunately are sometimes made for the machinability of certain cold finished steel bars. The result is that knowing minds tend to be skeptical about all specific machinability claims.

MACHINABILITY A RELATIVE TERM

And rightly so, for "machinability" is a relative term. Machinability is defined at Bliss & Laughlin as the machining characteristic of the steel which most economically fits your product and production. Four considerations determine the degree of free machining which should be sought: (1) The cost of the finished part, (2) the rate of production possible, (3) the finish required and (4) the tool life wanted.

WHICH STEEL IS MOST MACHINABLE?

It is clear that no one of the so-called "highly machinable" steels can always be recommended for all production. Instances have been noted, for example, where plain carbon steels are better machinability buys than leaded steels, which are recognized as being the freest machining of all steels. When asked which steel should be purchased for its machinability characteristics, we must say "that depends on your product and your equipment."

CONSERVATIVE MACHINABILITY CLAIMS

During the nearly 70 years which Bliss & Laughlin has served American industry, the company has been notoriously conservative about machinability claims. As America's largest specialized producer of cold finished steel bars, Bliss & Laughlin recommends the steel which provides *the best machinability at the best price for the part to be produced on your equipment.* Available for your production needs is a complete range in all grades of carbon and high carbon steels, regular and leaded, alloys and heat-treated steels. Bliss & Laughlin is prepared at all times to meet your specifications without equivocation.

MACHINABILITY EXPERTS AVAILABLE

Because Bliss & Laughlin has no favorite analysis to promote, offering all analyses, its machinability advisory service can be particularly valuable during both planning and actual production. Bliss & Laughlin's machinability engineers are available to trouble-shoot existing machinability problems in your plant or to provide metallurgical and technical assistance in helping you select the most economical grade of steel before jobs are started.

There will be no confusion about machinability claims if you place your problem in the hands of a Bliss & Laughlin representative. If he doesn't have a ready answer, a Bliss & Laughlin machinability engineer will. Check the telephone classified pages for the nearest representative or write or telephone the nearest plant below.

A. D. Kondrath (left), a B&L Machinability Engineer, is one of the country's authorities on the machinability of cold finished steel bars. Typical of his work with customers is pre-production selection of the most machinable bar stock for the job, considering the finish desired, the rate of production possible, and the tool life.

A practical recommendation is always assured because Bliss & Laughlin backs its recommendations with actual tests on its own machine tool in B&L's Customer Service Laboratory. Here Mr. Kondrath is discussing the machinability of the steel recommended as being the most suitable for a customer's product and production.

After a customer receives the B&L steel recommended as being most machinable for the part on the machine tool which will be used, there is continuous assurance that production will run smoothly and that the finished part will meet specifications—very important reasons why B&L machinability recommendations are worth seeking.

Specialists in Finish, Accuracy, Straightness, Strength and Machinability

BLISS & LAUGHLIN

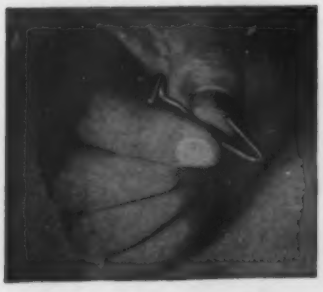
GENERAL OFFICES: Harvey, Ill. • PLANTS: Harvey, Detroit, Buffalo, Mansfield, Mass.

Largest Independent Producer of Cold Finished Steel Bars

CIRCLE 345 READER SERVICE CARD

NILSON 4-SLIDE TAKES A TOUGH ONE . . .

Mass production of body trim clips for a leading make automobile proved a complex forming problem. A. H. Nilson's 4-Slide (Model S-4-T) did the job, forming .025" x 3", 1065 C.R.A. steel at 54 strokes per minute! Accurate, fast, and automatic, Nilson 4-Slides keep pace with one of the nation's biggest industries.



THIS ONE WAS EASY . . .

A Nilson 4-Slide, Number 1, forms 150 drapery hooks per minute from 0.70 basic steel wire. Nilson 4-Slides form wire or ribbon stock from the coil. They straighten, feed, pierce, blank, swage, stamp or coin, cut and form in one, fast, automatic operation . . . accommodate wire up to .5" dia., in feeds to 32" max., and ribbon up to 3.5" wide. Press sections from 5 to 75 tons.

A. H. Nilson provides forming recommendations from detailed information without obligation. Send for catalog.

A.H. NILSON MACHINE COMPANY

1501 BRIDGEPORT AVENUE, SHELTON, CONN.

Automatic Chain Making Machines : Staple Forming Machines : Wire and Stock Reels : Wire Straightening Equipment : Slide Feeds for Presses

Free Literature

To order any of these bulletins, circle corresponding number inside back cover.

40 TUBULAR PRODUCTS—*J Bishop & Co, Malvern, Penna.* 16-page catalog 12 presents information on types, grades, lengths, finishes, and general characteristics of small-diameter stainless steel, nickel and nickel alloy tubing; glass-to-metal sealing alloys; super and precipitation hardening alloys, and fabricated tubular parts.

41 METALS, MINERALS, CHEMICALS—*Foote Mineral Co, 18 W Chelten Ave, Philadelphia 44, Penna.* Three lists arrange products in tabular form according to: uses and areas of interest; processes; and markets. Products include cobalt, electromanganese, iron powder, lithium metal and chemicals, manganese chemicals, nickel, silicon, and zirconium.

● SPHERICAL ROLLER BEARINGS —*Torrington Co, Bantam Bearings Div, South Bend 21, Ind.* Illustrated catalog 258 covers five standard series of self-aligning units with bore sizes from 40 through 1060 mm. Contains dimension tables, load ratings expressed as basic dynamic capacity, and line graphs showing modifying speed and life factors. Includes data on selection, calculating bearing life, limiting speeds, lubrication, shaft and housing fits, axial location, and sealing devices. Request direct on company letterhead.

42 PIPE AND TUBING — *Damascus Tube Co, Greenville, Penna.* 44-page handbook presents information on rare and reactive metal tubing for applications in the chemical, nuclear, and missile fields. Contains data on applications, neutron transparency, heat treatment, corrosion resistance, chemical and physical analysis, and mechanical properties. Wall chart also available indicates comparative corrosion effects of 44 common corrosive solutions on zirconium, titanium, tantalum, Hastelloy C, and Stainless 316.

43 FLEXIDYNE DRY FLUID DRIVES AND COUPLINGS—*Dodge Manufacturing Corp, Mishawaka, Ind.* 24-page bulletin A-640B illustrates and describes expanded line including 10 stock couplings and 8 stock drives ranging from fractional to 1000 hp. Tables facilitate selection for normal and heavy-duty service.

44 MAGNETIC EQUIPMENT—*Stearns Magnetic Products, 635 South 28th St, Milwaukee 46, Wis.* Products described include equipment for protection against tramp iron, such as magnetic pulleys; suspended magnets; drum, plate, grate, and spout magnets, and an electronic metal detector; materials handling equipment, i e, lifting and holding magnets; parts separators, hand magnets; portable drill stand and grinder holding magnets. Reference number is listed after each product description so that complete catalog can be obtained on any of the individual items.

45 POWER CYLINDERS—*Miller Fluid Power Division, Flick-Reedy Corp, 2040 N Hawthorne Ave, Melrose Park, Ill.* Literature discusses factors often overlooked in selecting cylinders for specific applications. These include operating conditions, cylinder design, and material considerations. Factors of safety required for ductile materials and cylinders of bolted, threaded, or keyed construction are discussed together with fatigue strength of materials, and effect of backlash.

46 V-BELT DRIVES—*B F Goodrich Industrial Products Co, Akron, Ohio.* 12-page illustrated manual deals with the subject of how to get longer life from these drives. Tells how to select and install, how to detect trouble, diagnose and correct belt failures. List of tips for proper maintenance is included as well as suggested inventory survey checklist for drives.

Top Tooling is a 3-way responsibility of a 3-Man Team: (1) Your Tool Engineer—who knows your customer's requirements and the job schedule. (2) Your machine operator—who knows the ability and limitations of the machine, and (3) Your Kennametal Carbide Engineer—who knows which carbides to use and how to apply them.

It takes this 3-Man Team to modernize TOOLING for PROFITS

Leading tool engineers agree that the metalworking industry has been losing thousands of dollars annually through improper tools and techniques. But today's business climate dictates a good hard look at loose production practices . . . large tool inventories, costly regrinding, less-than-possible output! It's time to TOP TOOL, which means to get the *right tool* on every job—on *every machine* in your line.

Here's how your KENNAMETAL* CARBIDE ENGINEER can help you Tool for Profits:

1 With Kennametal tooling service

Helping you choose and apply the tools that will machine every job at a profit is the Number 1 assignment of your Kennametal Carbide Engineer. Your knowledge of the shop and job requirements, plus his thorough knowledge of Kennametal Tooling, give you the Top Tooling for increased profits.

2 With the right grade for every job

Once a study has determined the best tooling for your operations, the comprehensive Kennametal line provides a performance-proved grade to meet the specific needs of every job.

General purpose needs can be satisfied from Kennametal Group I grades which were recently expanded by the addition of grades K4H and K2S.

By moving these grades, previously classed as "premium," into the General Purpose Group, Kennametal now provides a total of seven economy-priced grades suitable for a broad range of jobs —and has opened the door to further savings by reducing inventory requirements.

For the ultimate in performance on specific jobs, Group II provides a grade selection tailored for today's high alloy materials, closer tolerances, higher cutting speeds, and specialized operations.

3 With the right tool for every operation

Kennametal offers you the world's most complete line of brazed and clamped-insert type tools . . . spearheaded by the Kendex† line with more than 50 standardized styles plus many adaptations for special needs.

Let your Kennametal Carbide Engineer work with you to get the best tooling on your machines to squeeze more profit from every job today . . . and help you get set for stiffer competition tomorrow. Call him now, or write KENNAMETAL INC., *Latrobe, Pennsylvania.* 3176

*Trademark. †Trademark. U.S. Patent 2,848,789

INDUSTRY AND
KENNAMETAL
...Partners in Progress

Allison-Campbell

ABRASIVE CUTTING KNOW-HOW

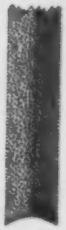
ACCO for Better Values

WHEEL EDGES TELL THE STORY!

NORMAL • *The right abrasive cutting wheel, properly applied, produces edges like these:*

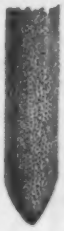
Slightly rounded edge is a sign of the right wheel properly applied to the cutting of solid bar stock up to 12 inches square. You'll get fast cutting and long wheel-life with the right abrasive cutting wheel.

A wheel which retains its **square edge** is well-suited to cutting both—solids, and structurals or tubing of medium wall thickness. A good general-purpose wheel is required for these mixed cutting operations.

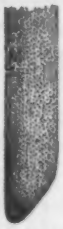


This **edge** is **slightly concave.** It should appear this way when you've used the right wheel to cut light tubing or other thin-wall sections. ALLISON wheels designed for this application make burr negligible.

ABNORMAL • *The wrong wheel, or improper application, produces edges like these:*



A **slightly pointed edge** means a wheel mismatched to the cutting job. A wheel which looks like this is too hard, doesn't break down uniformly. The tapering effect can produce wheel binding and breakage, and can burn the cut.



A **"chisel" edge** shows uneven wear, faster breakdown of the wheel on one side than on the other. It's the result of improper application of coolant in wet cutting. The result—shorter wheel life, and crooked cuts.

When the abrasive grain on the wheel edge wears smooth without being torn out, the **edge** becomes **"glazed,"** and the wheel loses its cutting efficiency. This condition is easily avoided by proper wheel application.

Abrasive Cutting Can Give You CLEANER Cuts—Faster

Cutting speeds of a few seconds per square inch, on almost *any* material, mean substantial time savings. Even titanium can be cut quickly and economically with the right abrasive cutting machine and wheel.

Fine finish obtained from abrasive cutting avoids burn, minimizes burr, and reduces or eliminates additional finishing operations.

Accuracy of CAMPBELL machines permits cutting within the closest tolerances, reduces rejects and scrap loss.

A complete selection of machines and wheels for *any* cut-off application is offered by ALLISON-CAMPBELL. Four types of CAMPBELL machines—chop stroke, oscillating, horizontal, and rotary—in capacities from the smallest stock to 14″ rounds . . . billets up to 12″ square . . . plate up to 6″ thick and 20 ft. long. ALLISON wheels—more than 150 different specifications—rubber or resinoid bond—3″ to 34″ diameters—.006″ to 3/16″ thick.

Application help is available from your ALLISON-CAMPBELL Field Engineer. His know-how is your assurance of the efficient, accurate, and economical cutting you can expect from modern abrasive cutting techniques. Call on him for expert advice.

WRITE FOR NEW BULLETIN

ALLISON-CAMPBELL Division has a modern, fully equipped Demonstration Laboratory in which your own cutting problems can be analyzed. Write for a copy of DH-20, a new bulletin describing these services. Details on ALLISON Abrasive Cutting Wheels and CAMPBELL Machines are also available.

ALLISON-CAMPBELL DIVISION
AMERICAN CHAIN & CABLE

923 Connecticut Avenue, Bridgeport 2, Conn.

ACCO

William J Stewart, vice president and general manager of Cleveland Punch & Shear Works Co, Cleveland, has been elected president of the company

Stanley E Casson has been made director of sales of National Acme Co, Cleveland. He has been Detroit area sales manager for the past 23 years

F B Wilkinson, vice president of Logansport Machine Co, Logansport, Ind, has been elected president to succeed **Mrs E P Wilkinson,** named board chairman

NAMES IN THE NEWS...

Norman F Garrett has been elected vice president and general manager for manufacturing of Crane Co. He had been general manager of the company's Chicago manufacturing division. **Walter Kovalick,** production manager, has been promoted to assistant general manager of the division.

Herbert Harig, president of Harig Manufacturing Corp, Chicago maker of tools and dies, and machine tools, has been named by the US Dept of Commerce as a member of a six-man trade mission team to India. He will serve as a specialist in the tool and die field.

Leonard C Barr has been elected executive vice president of Gregory Industries, Inc, Toledo, Ohio. He has been vice president and director of operations since 1956, and was sales manager of Nelson Stud Welding, acquired by Gregory 10 years ago. **Richard E McGinnis** has been promoted from field sales manager to vice president, sales.

Maynard F Carter has been named vice president of Worcester Pressed Steel Co, Worcester, Mass. In addition to his responsibilities as secretary and controller, he will assume general supervision of plant activities.

Robert O Greenshields has been named manager of the Detroit plant of Budd Co. He was formerly master mechanic there.

H Merrill Bowman, formerly vice president of American Pulley Co, Philadelphia, has joined T B Wood's Sons Co, Chambersburg, Penna, maker of power transmission machinery, as vice president and director of sales. He succeeds **Gordon M Henderson,** vice president, who will assist the president in administrative and production operations.

Manuel Tama, vice president and general manager of Ajax Engineering Corp, Trenton, NJ, has been elected president to succeed **Dr G H Clamer,** named board chairman. **Mario Tama,** secretary and research engineer for the company, has been elected vice president.

David W Bonnar has been named sales manager of Torc-Pac presses for Clearing Machine Corp, Chicago. He was previously senior sales engineer in the Detroit office.

George Stern, a specialist in high temperature treatment of metals and in powder metallurgy, has joined Nuclear Development Corp of America as manager of the materials department. He was formerly technical director of American Sinsteel Corp.

William S Mahoney has been elected president of the Ramsey Corp, St Louis subsidiary of Thompson Products, Inc, of Cleveland. Mr Mahoney was formerly vice president and general manager of Ramsey, manufacturer and distributor of piston rings.

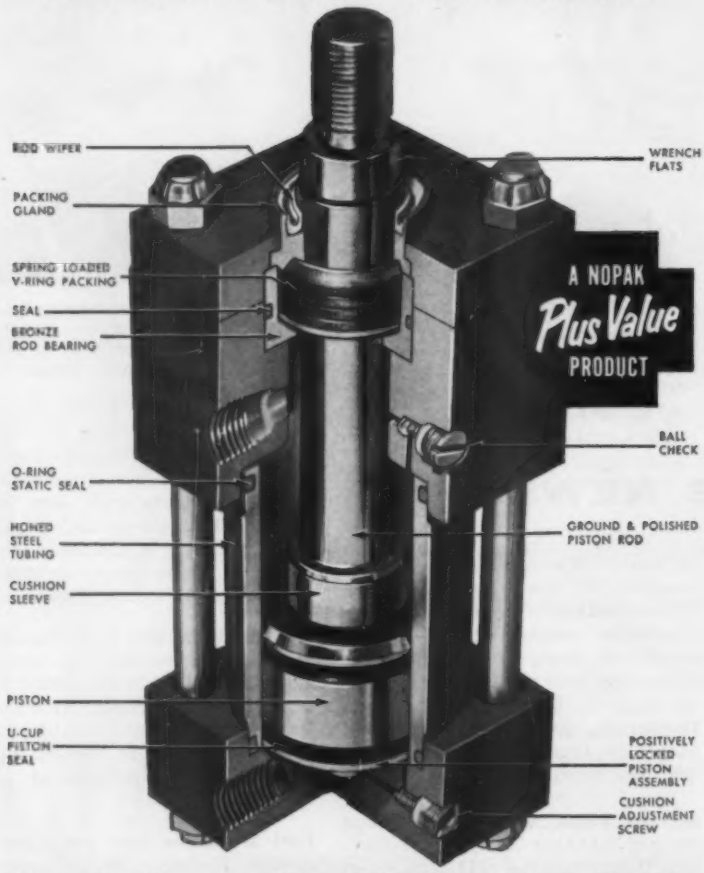
Earl M Barden has been appointed special Detroit sales engineer for Electric Auto-Lite Co, Toledo. Associated with the automotive industry for the past 32 years, Mr Barden most recently served as director of technical services for the Hupp Corp.

Ernest A Goetz has been appointed technical assistant to the president of American Bosch Arma Corp, New York. He will continue to serve as chief engineer of the Arma Division.

Lawrence E Nelson has been named vice president, sales, of Chrysler Corp's Marine and Industrial Engine Division. He was formerly director of vehicle sales for Chrysler Motors.

Kenneth Morris, who has been manager of Boeing's Moses Lake, Wash, Flight Center, has been promoted to factory manager of the company's Seattle Division. He succeeds **S O Svendsen** who has moved to the Transport Division at Renton, Wash, as assistant manufacturing manager in charge of production and industrial engineering. **Robert R Dickson** has been promoted from manager

POWERIZE with NOPAK
for Plus Value Performance



Class 3, Square Head Hydraulic Cylinders

Pressures 3,000 P. S. I. operating, 5,000 P. S. I. proof

Check these Class 3 Plus Values...

- Interchangeable with other well-known square head, hydraulic cylinders
- NOPAK Class 3 Cylinders comply with J.I.C. standards
- Positively locked, one-piece concentric piston
- Piston Construction...
  Self-compensating U-cup *(standard)*
  Multiple seal piston ring *(optional)*
- Expansion Joint Type Tube Seal †...
  Cannot extrude at excessive shock pressures
  Provides bleeder by-pass location at highest internal point
  † a NOPAK *first* since 1948
- Steel Construction for Strength and Durability...
  Heavy Honed Steel tube, Steel heads, High Tensile Steel piston rod and tie rods
- Multiple V-Ring Rod Seal and Wiper
  Requires no adjustment
  Assures longest possible trouble-free operation
- Cushion Adjustment Screw and Ball Check...
  Maintains minimum head dimension
  Identical seats provide interchangeability
- Bore sizes from 1½" through 12"
- 18 Standard mountings
- More power per dollar

Ask for Catalog 103... It contains complete Data and Dimensions.

NOPAK VALVES and CYLINDERS

GALLAND-HENNING NOPAK DIVISION • 2707 S. 31st Street • Milwaukee 46, Wisconsin

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NAMES IN THE NEWS...

of production engineering in the Industrial Products Division at Seattle to the new post of manufacturing manager for the division.

Donald R Spotz has been elected president and general manager of the Pesco Products Division and the Wooster Division of Borg-Warner Corp, Chicago. He was formerly vice president in charge of sales for Pesco

Edward M Feeley has been appointed vice president, sales, for Trinity Equipment Corp, Cortland, NY, manufacturer of thermowells, thermocouples and assemblies. He has been serving as sales manager. **Thomas A Boyle,** production manager, has been named vice president, manufacturing.

R C Vollmer, assistant general superintendent, manufacturing, at the main Dodge assembly plant in Hamtramck, Mich, has been general superintendent, trim, engine dress-up, chassis and final assembly. **F M O'Connor,** also an assistant general superintendent, manufacturing, has been appointed general superintendent, body construction and paint.

Jack L Stroman, founder of Stroman Furnace & Engineering Co, recently acquired by Heavi-Duty Electric Co, Milwaukee, has joined Hevi-Duty's staff as furnace consultant. **J C Smith,** former Stroman sales manager, has been named to handle sales of Stroman furnaces for H-D.

Felton H Havins has been named director of sales engineering for Anadite, Inc, of Texas, chemical milling and metal finishing firm located in Hurst. Company is an af-

Gregory Grant says —

COMPARE THE COSTS!

BUY GRANT *Customized* GEARS FOR O.E.M. AND SAVE 25%

Here is a typical comparison — 50 sets of gears and pinions to meet assembly specifications:

Set of stock gears unaltered	$20.20	Set of Grant customized gears to your specifications, ready for installation
Rebore shaft hole/per pr.	.80	
Cut keyway/per pr.	.50	
Drill and tap for set screw/per pr.	.40	
	$21.90 pair	$15.75 pair

Yes, you can save 25% in actual costs when you specify Grant customized gears instead of making time-consuming alterations to fit stock gears to your needs. Layout, scheduling and machine time are eliminated, plus hidden costs for paperwork, handling and spoilage.

In addition to cost savings Grant customized gears save you time because they are ready for immediate assembly; rigid inspection prior to shipment makes certain that all gears are uniformly accurate to insure maximum dependability and eliminate rejects.

For all original equipment applications, you will be dollars ahead when you specify Grant customized gears. Send us your specifications for an immediate quotation — no obligation of course.

ESTABLISHED IN 1877

GRANT GEAR WORKS, INC. WEST SECOND STREET, BOSTON 27, MASS.

• *Catalog Available on Customized Gears* • *Precision Gears* • *Speed Reducers*

CIRCLE 351 READER SERVICE CARD

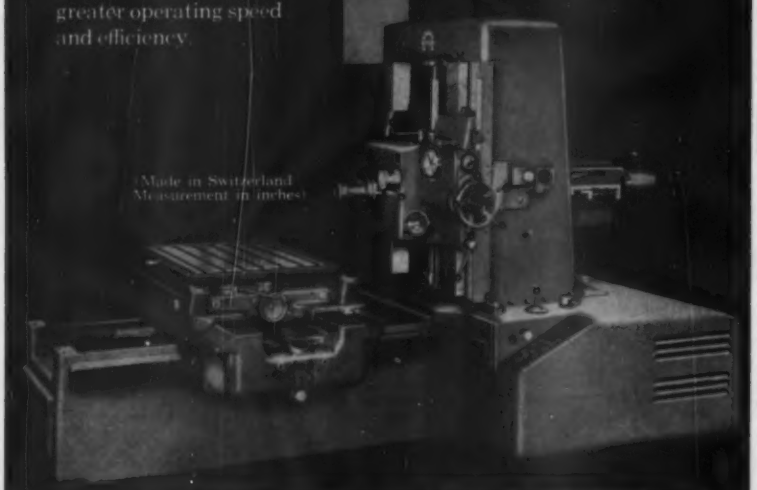
ACCURACY + VERSATILITY

the DIXI 75 gives you horizontal optical jig boring

- Projected optical setting—direct reading to .00005" for linear motions and 1 sec. of arc for built-in rotary table. Linear optics provided with adjustable zero reference.
- 3" diameter boring spindle
- Increased capacity: table size 39⅜" x 32"; 29½" cross travel; 23⅝" longitudinal travel; 25⅝" vertical travel

PLUS...

- Automatic positioning device available.
- Simplified controls functionally arranged for greater operating speed and efficiency.
- Hydraulic feeds and infinitely variable spindle speeds.
- Rear support optional.



MBI has engineers available for consultation, guarantees service by factory trained staff, and stocks spare parts in New York. — Join the long list of leading aircraft and manufacturing plants throughout the United States which are using the horizontal optical jig borer.

See the Dixi 75 at our Cleveland Demonstration Center (Sloan Machine Co., 18714 Nottingham Road, Cleveland, Ohio)

MBI

M. B. I. EXPORT & IMPORT LTD.

A DIVISION OF MACHINERY BUILDERS, INC.

475 Grand Concourse, Bronx 51, N. Y.

"Over 25 years' experience in designing and building machinery."

NAMES IN THE NEWS...

filiate of Anadite, Inc, of California. Mr Havins was formerly chief project engineer of Brunswick-Balke-Callendar.

John S Overholser, chief engineer of Tamar Electronics, Inc, Los Angeles, has been named director of research engineering. **Kenneth E Wilcox,** assistant chief engineer, succeeds Mr Overholser, and **Rex C Bean,** chief microwave engineer, takes over Mr Wilcox' former post.

Frank P Blonska, formerly administrative assistant to the sales manager of Cleveland Cap Screw Co, has been appointed sales manager, central states, with headquarters in Chicago.

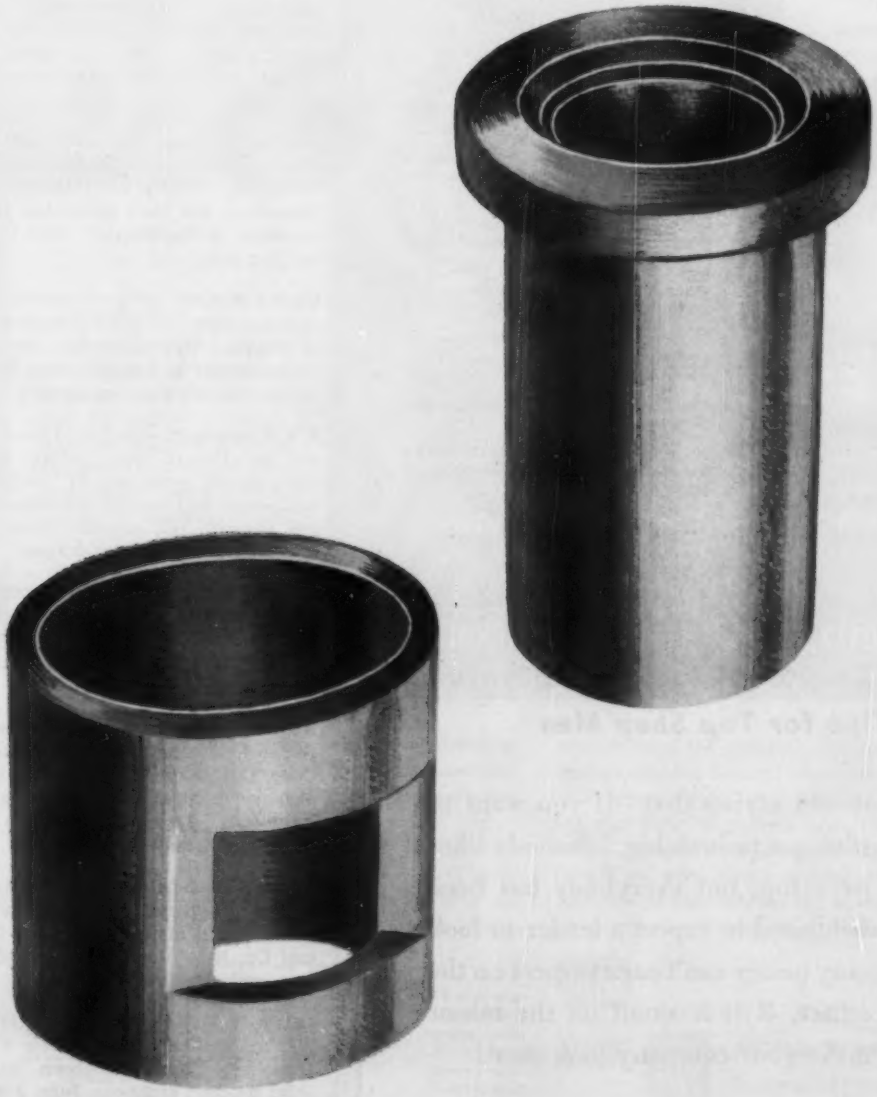
Tom Carroll (top), sales manager, has been named vice president, sales for Dumore Co, Racine, Wis. **Harry Wardrip,** assistant sales manager, has been appointed to Mr Carroll's former post

Thomas L Case, formerly with Westinghouse Electric Corp, has joined C I Hayes Inc, Cranston, R I, as assistant to the chief engineer.

Neil McCormick, procurement branch manager for Boeing Airplane Co's Systems Management Office, Seattle,

5 Positive ways **Asarcon® continuous-cast bearing bronze saves you money: 1) Exact lengths. Order Asarcon 773 (SAE 660) in exact lengths you need, up to 105″. No short-end scrap as from ordinary cast bars. 2) Close-to-size. Asarcon 773 gives you only 1/32″ to 3/32″ to machine off, in diameters from 1/2″ to 9″. 3) Less machining. Less stock to remove saves machining time and cost. 4) No blow-holes, pits, or shrinks. No sand to dull tools. No hard or soft spots. No loss of machining time or parts thrown away because of metal defects. 5) Less down-time. The better, more uniform properties of Asarcon 773 assure longer life of important machine parts, and fewer breakdowns. Asarcon 773 bearing bronze is carried in 260 stock sizes, solids and tubes. See your local distributor or write Continuous-Cast Products Department, American Smelting and Refining Company, Barber, N. J.; on the West Coast, Kingwell Bros., Ltd., 457 Minna St., San Francisco; in Canada, Federated Metals Canada, Ltd., Montreal and Toronto.**

CONTINUOUS-CAST DEPARTMENT OF



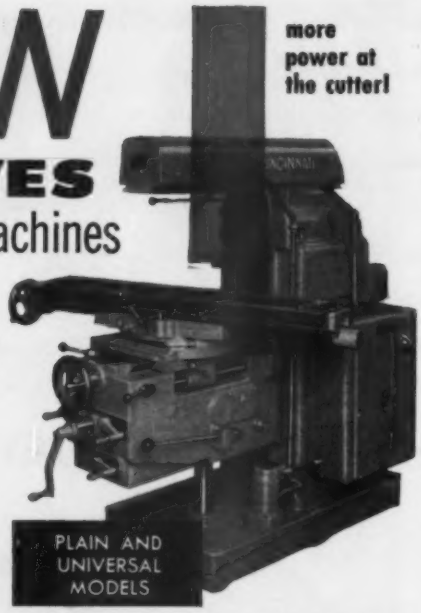
ASARCO

AMERICAN SMELTING AND REFINING COMPANY

CIRCLE 353 READER SERVICE CARD

new GREAVES 2-XH Milling Machines

more power at the cutter!



The completely new GREAVES No. 2-XH Milling Machine brings added versatility, increased operational ease, and more power where it's needed most . . . *at the cutter!*
It utilizes two motors, one for spindle drive; a separate motor for moving table, saddle and knee. Compare this and the other outstanding features of the new Greaves Mill. You'll see why Greaves is "The MOST Mill for the LEAST Money."

Write for detailed literature!

- Wide range of speed/feed combinations for any type material, any type job.
- Heavy, internally ribbed column casting and heavy duty rectangular overarm for maximum rigidity.
- Large, heavy-duty knee, saddle and table provide accuracy for all types of milling.
- New 7½ HP spindle drive motor, with separate motor for movable components, provides extra power for heavy milling.
- Easy-to-reach controls. Handwheels and vertical crank disengage automatically when not in use.
- New rapid traverse lever within operating control area.
- Separate drive motor for table, saddle and knee provides more smooth balanced power at the cutter.

GREAVES

J. A. FAY & EGAN COMPANY
2100 Eastern Avenue, Cincinnati 2, Ohio

CIRCLE 354 READER SERVICE CARD

From the *American Machinist* Library of *Tips for Top Shop Men*

THERE'S an old saying that "If you want to be big, you've got to look big." Nobody likes a fourflusher or a fop, but everybody has been trained from childhood to expect a leader to look like one. Company policy can't earn respect on the major things either, if it is small on the minor things. Don't make your company look small.

NAMES IN THE NEWS . . .

has been given additional duties as acting operations manager for the office, which is responsible for planning of new space age weapons systems for Boeing.

D R Berg has been appointed manager of the new product development department of Dravo Corp, Pittsburgh. He has been serving as supervisor of product development for the company's Machinery Division.

W W Wellborn, formerly manager of new products research, has been appointed technical director of the Carbide Division of Firth Sterling Inc, Pittsburgh.

Louis A McGowan, chief engineer of Rockwell Mfg Co's DuBois, Pa, gas meter plant, has been appointed assistant chief engineer, Barberton Division.

George M White, formerly staff assistant to the works manager of the Wisconsin Works of International Harvester, has been appointed plant manager of Heppenstall Co's Pittsburgh plant.

Hardie W Beck has been named general manager of the Pittsburgh plant of Joseph T Ryerson & Son. He succeeds **Arthur L Peterson** who is retiring after 45 years of service.

E F Winterfield, director of purchasing for Bernco Engineering Corp, Indianapolis producer of electronic equipment and metal fabrications for the aircraft and missile industries, has been made plant manager.

Gordon C Curry has been promoted from sales manager to vice president, sales, of the Dollin Corp, Irvington, NJ, producer of zinc and aluminum die castings.

Ardmore M Willer has been appointed sales manager of West Instrument Corp, Chicago manufacturer of temperature control and recording instruments. He moves up from the post of assistant sales manager.

Edward Bachorik has been promoted from regional sales manager to general sales manager of Allied Control Co, New York producer of relays, switches, and valves.

Lewis W McKee, assistant chief engineer, product, for Barden Corp, Danbury, Conn, has been named chief product engineer. **John J Murphy,** research coordinator, has been

BRASS
Bridgeport
CO.

At Bridgeport Brass plant in Indianapolis a 38"-dia. Atkins Segmental Saw is shown cutting 10" extrusion billets. These are Bridgeport's famous Duronze III billets made from high strength, corrosion resistant silicon aluminum bronze. Rate of feed is 14 inches per minute. Note smooth burr-free side wall on newly-cut billet.

ATKINS

rate best in the toughest test of all:

cutting Copper Base Alloy Extrusion Billets

● There's no better way to test a saw's cutting ability than on copper alloy. This hard-to-machine metal clogs conventional tooth gullets and galls the sides of the saw, often stalling the machine.

Atkins' patented "curled chip" tooth design puts an end to these problems. Ordinary saw teeth (Fig. 1) wedge chips into the gullet; Atkins teeth (Fig. 2) *lift* the chips in a continuous curling action. Chips explode from the gullet like suddenly released clock springs, leaving a clean, free-cutting tooth edge.

You can *double your rate of feed* with Atkins "Curled Chip" Segmental Saws. Use them for heavy duty cutting of both ferrous and non-ferrous metals. You'll get more cuts per grind at lower tool cost. And Atkins segments are the economical way to replace worn teeth without discarding the saw plate.

FIGURE 1
Conventional Tooth

FIGURE 2
Curled Chip Tooth

Write for 16-page Atkins catalog covering circular and band saws for every metal-cutting need.

ATKINS Silver Steel SAWS

ATKINS SAW DIVISION
BORG-WARNER CORP.
Indianapolis 9, Indiana

BW

CIRCLE 356 READER SERVICE CARD

Pure dependability
for metal cleaning
DETREX
PERM-A-CLOR NA*
(Trichlorethylene)
Only DETREX, with experience and facilities unmatched in the metal cleaning industry, could have produced PERM-A-CLOR NA. Setting new standards in stabilization, this ultra efficient, superior solvent is another example of Detrex leadership in metal cleaning materials, methods, equipment and technical research and field service.
* * *
Depend on DETREX for Every Metal Cleaning and Processing Need
PERM-A-CLOR NA (Degreasing Solvent)
Solvent Degreasers
Ultrasonic Equipment
Industrial Washers
Phosphate Coatings and Paint Bond Compounds
Rust Proofing Oils and Compounds
Alkali and Emulsion Cleaners
Extrusion and Drawing Compounds
Spray Booth Compounds
Aluminum Finishing Compounds
*PERM-A-CLOR (NA) IS REGISTERED TRADEMARK OF
DETREX CHEMICAL INDUSTRIES, INC.
BOX 501, DEPT. AM-11, DETROIT 32, MICHIGAN

NAMES IN THE NEWS . . .

named contract research manager. **Kenneth D Mackenzie** has joined the company as advanced product manager.

Peter H Morganson has been appointed assistant chief engineer of Veeder-Root Inc, Hartford, Conn. He was formerly a works manager at General-Gilbert Corp.

George Gumas has been named vice president, engineering, at CDC Control Services, Inc, Hatboro, Penna, firm which specializes in building of dynamic process control systems. He has been serving as head of the analysis department, and manager of systems production.

George E McCreery has been appointed sales manager of socket screw products manufactured by Mac-it Parts Co, Lancaster, Penna. Mr McCreery has been manager of the Mac-it Screw Division of Strong, Carlisle & Hammond, formerly Mac-it's national distributor.

Dr Erwin A Horiak, chief engineer of Hercules Motor Corp, Canton, Ohio, has been appointed director of engineering. **J L Biasetti** succeeds Dr Horiak. **Harry Cuthbert** has been named chief engineer-advanced engineering, and **Robert E Kerr** will be in charge of all experimental laboratory activities.

Richard H Mather has been named vice president, production, of the Firestone International Co. Formerly general production manager, he will direct manufacturing in 25 Firestone plants in 15 foreign countries.

OBITUARIES

Russell M Fellows, chairman of the board and treasurer of the Fellows Gear Shaper Co, Springfield, Vt, died at his home on Oct 13 at the age of 66. He was the son of **Edwin R Fellows** who founded the machine tool company bearing the family name. He attended the public schools in Springfield, where he was born, and graduated from the Allen School in Newton, Mass. He began work with the Fellows company in 1911, became purchasing agent in 1916, and treasurer in 1939. He was elected a vice president in 1945 and early this year became board chairman.

Robert W Nelson, 48, vice president of American Air Filter Co, Louisville, Ky, died suddenly Oct 9.

New circuits in seconds at half the cost!

COORDINATED COMPONENTS. BullDog equipment works together to feed specific industrial, commercial or institutional power needs. Whether it be LO-X®, Plug-In Duct, a substation or a complete distribution system, BullDog can put your business in top electrical shape and keep it there! © BEPCO

As power goes, so goes production. Recently, an automotive parts plant smoothed major kinks in *both* with an installation of BullDog Plug-In BUStribution® Duct. Where powering new machines and constant shifting of existing equipment once meant electrical downtime and delay, machines now plug into power in seconds. No rewiring, downtime or costly production halts. And the electrical cost of moving and adding machinery has been slimmed by 47%.

Plug-In Duct is part of a complete *electrical* distribution system engineered by BullDog for capacity, reliability, *flexibility*. Very probably BullDog products can inject new efficiency and economy in your operations, too. Consult the BullDog Field Engineer or your electrical contractor. Or write BullDog Electric Products Company, Detroit 32, Michigan.

BULLDOG

BullDog Electric Products Company, Division of I-T-E Circuit Breaker Company, Detroit 32, Mich. *BullDog Export Division:* 13 East 40th St., New York 16, N.Y. *In Canada:* BullDog Electric Products Co. (Canada) Ltd., 80 Clayson Rd., Toronto 15, Ont.

HEAT BETTER ELECTRICALLY

CIRCLE 358 READER SERVICE CARD

CIRCLE R precision underwrites your precision by holding close tolerances. Our center drills include always-popular old standard letter drills, new standard number drills, and our Hi-Spiral drills.

On drilling problems, get in touch with Circle R specialists.

BURBANK	INDIANAPOLIS	PHOENIX
CHICAGO	MILWAUKEE	PITTSBURGH
CLEVELAND	NEW YORK CITY	PROVIDENCE
DAYTON	PHILADELPHIA	ROCHESTER
DETROIT	MONTREAL	ST. LOUIS
HACKENSACK	———	WESTBURY, L. I.

CIRCLE 359 READER SERVICE CARD

From the *American Machinist* Library of *Tips for Top Shop Men*

PROCEDURE for methods improvement: Pick an operation to be improved. Put down in writing what happens—the details. Challenge each detail in order. Where a chance for improvement appears, develop the better method. Apply it on the job.

NEW BOOKS...

TECHNICAL DRAWING—*By Frederick E Giesecke, Alva Mitchell, and Henry Cecil Spencer. Published by The MacMillan Co, 600 Fifth Ave, New York 11. 844 pages. Price $10.00.*

This is a fourth edition of a standard textbook on engineering drafting, in print for over 20 years. The book covers the fundamentals; instruments, lettering, construction, sketching, projection, dimensions, intersections, drafting problems, and gears, cams, and screw threads.

New for this edition are a large number of illustrations, plus the new ASA standard on drafting practices. Technical terms and Do's and Don'ts are new sections. The main chapters have been reorganized and and brought more up to date.

•

ELECTRONICS INDUSTRY DIRECTORY. *Published by Electronics Committee, Industrial Dept, Los Angeles Chamber of Commerce, 404 South Bixel St, Los Angeles 54, Calif. 160 pages, 8½ x 11. Paper bound. Price $2.50.*

Included in this publication is an alphabetical listing of companies engaged in electronic manufacturing in the Los Angeles metropolitan area, together with the names of key executives, plant size, number of employees, type of business, products, and market area served. Also included are statistics on the industry in the Los Angeles area, a list of professional and technical associations, a list of military buying and liaison offices, a product and service index, and a brand name index.

•

DIRECTORY, AMERICAN COUNCIL OF INDEPENDENT LABORATORIES INC. *Published by American Council of Independent Laboratories Inc, 4302 East-West Highway, Washington 14, DC. 100 pages 6¾ x 10.*

The increasing interest in research and development in modern industry has brought about a corresponding rise in the importance of the part played by independent laboratories in this field. Many plants lack the necessary staff and facilities to carry out needed research, and do not know where to obtain the serv-

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Your Machine Tool Output Deserves the Best in Gaging Equipment

PRECISION IS OUR BUSINESS

Accuracy to Millionths

PLAIN RINGS
A G D — Hardened throughout and stabilized. Steel — Chrome — Carbide.

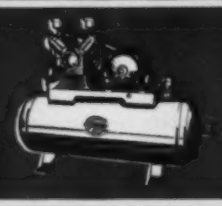
REVERSIBLE PLAIN AND THREAD PLUGS
For extra gage wear life. Steel — Chrome — Carbide Lapped finishes.

INSPECT-O-SCOPE BORE-O-SCOPE
Discover hidden dangerous wear flaws save time by making on the spot inspections. Custom designed to meet your special needs.

TAPERLOCK PLAIN AND THREAD PLUGS
Made to A G D specifications. Steel — Chrome — Carbide — Lapped finishes.

CENTERLESS LAPPING MACHINE
Tolerance to Millionths with ease.

TRILOCK PLAIN PLUGS
Hardened throughout — Steel — Chrome — Carbide. Range — .750" and larger.



AIR COMPRESSOR
Automatically shuts off both motor and compressor when oil level drops below the safety mark. '83 models from ¼ to 20 hp.

TRILOCK THREAD PLUGS
Lapped Finish — Steel — Chrome — Carbide. Range — .750" and larger.

PUNCH PRESS
New No. 65K back geared, 65-ton deep throat punch press with pin type clutch, multiple-jaw clutch or air clutch.

THREAD RINGS AND SET PLUGS
Lapped finish—Set Plugs Truncated at no extra cost. Root Relieved Rings.

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Made to individual specifications in limited or production quantities.

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Inspection Services for Industry to Bureau of Standards specifications.

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Punch Presses Since 1907

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HIS JOB

....TO BUILD
YOUR PROFITS!

THE *Roto-Finish* CUSTOMER'S MAN

There's nothing unique about stressing product quality. But, at Roto-Finish we have an added incentive. The success of the Roto-Finish Customer's Man *depends* on providing the kind of dependable, mass-production finishing service which builds customer satisfaction, and results in a steady repeat business.

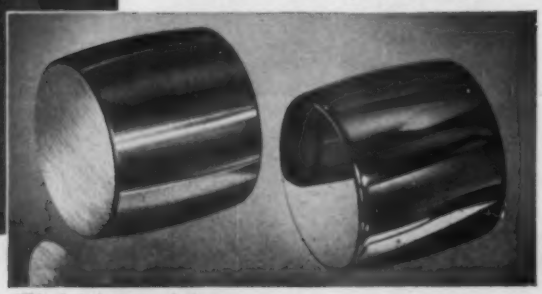
TRIAL AND ERROR FINISHING IS COSTLY

If you're now barrel finishing, our Customer's Man will welcome an opportunity to work with you in your own plant to show you how to get the finish you want, faster, and at lower cost.

If you're hand finishing, he can show you how to save up to 80% of your present finishing costs.

WANT PROOF? Then write or phone your Roto-Finish Customer's Man today.

ROTO-FINISH CASE HISTORY



***This photo is unretouched.**
MATERIAL: Bearing steel, 61 Rockwell C Scale.
DIMENSIONS: 1.213" dia. x 1.015".
FINISH BEFORE: Ground to 10 RMS.
FINISH AFTER PROCESSING: 2 to 4 RMS, (with no dimensional change).

Roto-Finish COMPANY

3723 Milham Road
KALAMAZOO, MICHIGAN
Phone: Fireside 3-5578

ROTO FINISH

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ices of competent personnel to do the work.

This directory lists the names and addresses of all ACIL members alphabetically, and by State and City. It also shows the names and qualifications of the company officers, the scope of activities covered, the services rendered, and the fields of specialization. An index of services shows all the member laboratories capable of performing a particular service in each of four geographical areas, and indicates those which specialize in that particular field.

•

IRON AND STEEL DICTIONARY. *Published by Verlag Stahleisen, Breite Strasse 27, Dusseldorf, Germany. 272 pages, 4 x 5¾. Price DM 12.50 ($3.00 approx). Distributed by H K Lewis & Co, 136 Gower St, London WC 1, England, at £1-1-4.*

The steadily increasing importance of German materials and products in the international market makes this pocket-size dictionary invaluable to importers, and users of German products. In addition, it will be extremely useful to engineers who need to read German technical literature. Containing over 7000 technical terms, many of which defy ordinary translation and are not found in standard dictionaries, it was compiled through the joint efforts of the British Iron & Steel Institute and the Verein Deutscher Eisenhuttenleute.

Although intended primarily for the Iron and Steel industries, it con-

"I appreciate your willingness to adopt new trends, Newton—but there is a limit to this throwaway tooling idea."

tains a number of terms encountered in Metalworking, laboratories, and general business. The final 20 pages contain useful conversion tables.

•

METALLURGICAL THERMOCHEMISTRY—*By O Kubaschewski and E LL Evans, Chemical Research Laboratory, Teddington, England. Published by Pergamon Press, 122 E 55th St, New York 22. 426 pages. Price $10.00.*

This is a third edition of a book originally published in 1950, revised extensively in 1955, and now revised to a minor degree in 1957. The book is written for research and process metallurgists who must apply chemical and thermodynamic equations in their work. It is therefore highly theoretical and advanced.

Subjects covered include the theory of thermodynamics in metallurgical chemistry, heat transfer, electrical charges, and gas phases. Almost half the book covers tables of values for heats of formation, thermodynamic values, and other standard data for metallurgical compounds. The final section covers a general method of dealing with metallurgical problems that include thermo and chemical elements.

•

INTRODUCTION TO FOUNDRY TECHNOLOGY—*By D C Eckey, professor, department of industrial engineering, Georgia Institute of Technology, and W P Winter, department of industrial engineering, The Pennsylvania State University. Published by McGraw-Hill Book Co, 330 W 42nd St, New York 36. 296 pages. Price $7.00.*

One of the favorite advertising approaches of welding-equipment suppliers is to illustrate how a cumbersome, wasteful casting can be redesigned to be produced as a clean, simple weldment at a great saving. This book turns the trick by showing several examples the other way around.

It is a book on fundamentals, tightly organized into 15 lectures on general casting theory, plus a second section split into brief descriptions of practical foundry equipment. The text is quite telegraphic in style, depending on lecture discussions to bring out details of ideas, techniques, and technicalities mentioned in the book. But the material is organized to a high degree, and contains con-

Let's cut out the

DOUBLE TALK

... *about* TAPS

Let's all admit a few general facts:

- There are some 23 tap manufacturers in the U.S., all making ground thread high speed steel taps of excellent quality — properly hardened, accurately ground, carefully inspected.
- They're *all* sharp, uniform, accurate, rugged, controlled and dependable.
- Everyone knows that taps from one good manufacturer will perform pretty much like taps from *almost any other good manufacturer.*

***So what can be said, more, about* TAPS?**
Briefly... and it's* news *to you... there's this:

1. Crōmclad Taps have a special hard chrome surface treatment (less than .00005" thick) developed by us specifically for taps.
2. This unique Crōmclad treatment reduces friction, loading and metal seizure — resulting in a substantial increase in tap life.
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5. Unconditional guarantee goes with Crōmclad Taps. If they do not perform to your satisfaction, they may be returned for full credit.
6. Crōmclad Taps are sold *at no extra cost* over conventional ground thread high speed steel taps.
7. *Attractive quantity discounts* are available on an *above-board* basis, quoted openly in our price list.

Crōmclad TAPS

We invite you to read these 7 points over again —then mail coupon today for detailed price list.

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Send price list on Crōmclad Taps to

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Company_____

Street_____

City & State_____

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Tell at a glance how fast you can finish bores with a

FULMER HONING MACHINE

Simple as A-B-C. Merely Set Diameter—Length—Material Read off: HONING TIME!

Computer also shows other useful data on speeds, stones etc.

Anyone who uses honing needs this handy computer. Anyone who does bore finishing by any method owes it to himself to check up on the actual, positive saving in time, labor and equipment capacity with Fulmer Honing Equipment.

Fulmer Honing Machines cost as little as **half the price** of other makes . . . **equal** or **exceed** them in rate of stock removal, accuracy, ease of operation and set-up. Vital parts . . . such as bearings and gears . . . are engineered with 100-plus safety factor to stand up under 3-shift, 7-day service for years.

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THE WORLD'S BEST
FULMER *honing equipment*

CIRCLE 364 READER SERVICE CARD

DID YOU KNOW

. . . that you will find more advertising for machine tools in *American Machinist* than appears in any other magazine in the world?

All of it will guide you to the best in modern machining methods and equipment. You spend time well when you spend it in the pages of *American Machinist*.

siderable information almost in handbook style. For example, there is a scale of melting temperatures of metals and alloys, and there is a table of iron alloys with their analysis, strengths, and characteristics in physical appearance.

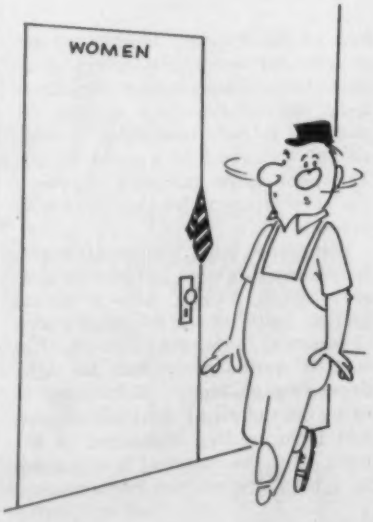
The book is aimed for an early college course for engineers, and is not intended to help develop foundry skill in its readers; only familiarity with foundry practices in the respects with which they affect engineering.

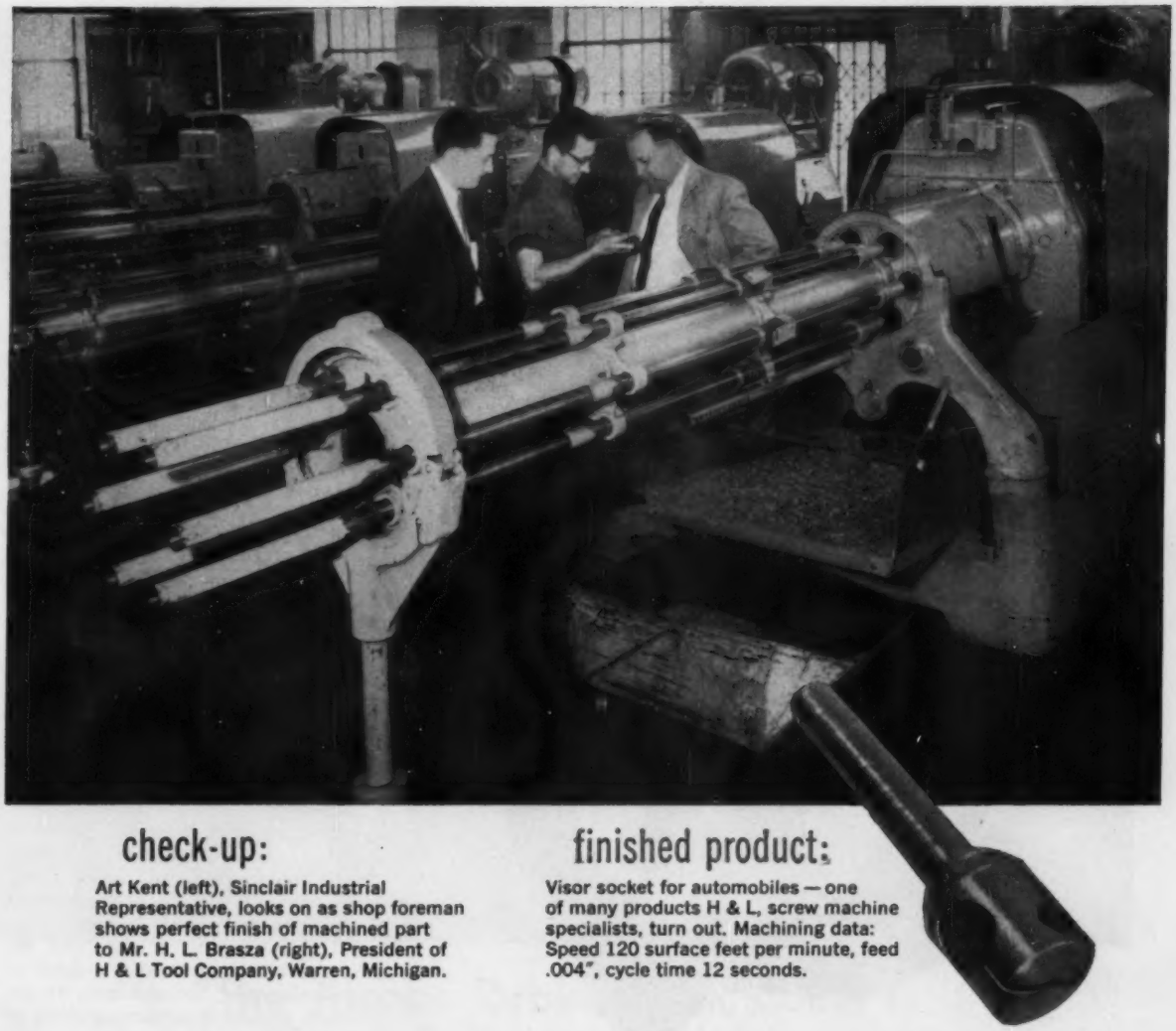
•

NORTH CAROLINA METALWORKING FACILITIES DIRECTORY. *Edited by A A Carlyle. Published by School of Engineering, North Carolina State College. 180 pages 8½ x 11. Price 50 cents.*

This publication will certainly be an eye-opener as to the extent of Metalworking in North Carolina, and it will be of tremendous value to manufacturers in the area. It lists some 150 metalworking companies in the State, gives their locations, principal products, number of employees, the types and number of machine tools and processing equipment installed, and the percentage of capacity of each machine available for prime or subcontract work.

The book contains three indexes: by machine or process, by geographical location, and alphabetically by company. It is thus a simple matter for a user to find the company nearest to him that has capacity to perform the particular operation or service he requires. The publication will also be of great value to manu-





check-up:

Art Kent (left), Sinclair Industrial Representative, looks on as shop foreman shows perfect finish of machined part to Mr. H. L. Brasza (right), President of H & L Tool Company, Warren, Michigan.

finished product:

Visor socket for automobiles — one of many products H & L, screw machine specialists, turn out. Machining data: Speed 120 surface feet per minute, feed .004", cycle time 12 seconds.

H & L cuts inventory to one cutting oil...CLAIRO® 16

H & L Tool Company started saving money the day they switched to CLAIRO 16, Sinclair's new Cutting Oil. Head man H. L. (Hank) Brasza says: "CLAIRO 16 did away with the need for several different cutting oils."

"CLAIRO 16 is applied to all H & L machining operations for cutting a variety of steels, including the critical types such as #303 Stainless and AISI-4150. CLAIRO 16 makes it possible for us to machine parts manufactured from AISI-1018 cold rolled bar stock most satisfactorily."

Mr. Brasza continues: "We're also very pleased with the excellent tool life and finish we get with CLAIRO 16."

You, too, can benefit from the advantages of CLAIRO 16 Cutting Oil. Contact your local Sinclair Representative or write for free literature to: Sinclair Refining Company, Technical Service Division, 600 Fifth Avenue, New York 20, N. Y. *There's no obligation.*

SINCLAIR

CUTTING OILS AND COOLANTS

facturers who may be planning to locate in North Carolina, as it will enable them to see at a glance what ancillary services will be available in the area selected.

This being the first edition, it is admittedly not 100% complete, but plans are under way for a new and larger edition next year. Meanwhile, the present edition rates a place on the desk of every purchasing agent, production and cost-control engineer, or other personnel interested in getting work done that is outside the capacity of his own plant facilities.

•

OPTIMALE STUFENRADERGETRIEBE FUR WERKZEUGMASCHINEN (OPTIMUM STEP-GEAR DRIVES FOR MACHINE TOOLS). *By E Stephan. Published by Springer Verlag, Reichpietschufer 20, Berlin, W Germany. 102 pages, 6¼ x 8¼. (German language) Price DM 21 (Cloth binding DM 25.)*

The book shows how to solve problems of designing and calculating machine-tool drives to obtain an optimum arrangement of the gears without laborious cut and try methods.

The first part deals with types of drives, apportionment of the steps, calculation of the transmission, number of teeth, and so on. Instructions are given for determining the number of revolutions per minute and, by use of a slide rule and a sheet of squared paper, for obtaining an accurate picture of the arrangement of the power ratios.

The second part is concerned with

SHOW STOPPER

It's the new Torrington Verti-Slide, the first major innovation in the field of 4-SLIDE equipment in 50 years!

This machine was designed to meet a growing need for greater productivity and profitability in the cost-critical area of wire and strip forming.

Seldom before has a new machine created such immediate and widespread interest. We urge you to get the full story. Write or call today.

THE TORRINGTON MANUFACTURING COMPANY

"This is what I need in a wife; good coffee and no back talk."

Drilling bar stock to close tolerances in I.D. at the Hartford Special Machine Co.

"The Jacobs Rubber-Flex Collet is the best collet I have ever used"

Albrecht Keyless Chuck and Jacobs Rubber-Flex Collet Lathe Chuck team up on center drilling job.

Mr. Shaler Rundberg drills steel bar on LeBlond Dual Drive 12" Lathe equipped with a Jacobs Model 91 Rubber-Flex Collet Chuck at head stock, and an Albrecht Model 130 J6 Keyless Drill Chuck at the tail stock. He often works with highly polished or finely ground parts. He says:

"The Jacobs hand wheel type lathe chuck lets me chuck polished or ground parts for additional operations without marring. The Rubber-Flex Collet is the best collet I've ever used."

You hold your work with the tightest, most accurate grip ever devised when you hold with the Jacobs Rubber-Flex Collet. Ask your industrial supply distributor for Bulletin 57-CC on the Model 96 Key Type Collet Chuck shown here and for Bulletin 57-LC on the Model 91 Hand Wheel Collet Chuck.

Jacobs and your industrial supply distributor are ready to deliver the chucks you need and the service you deserve. First in chucks . . . first in service.

Jacobs CHUCKS

The Jacobs Manufacturing Company, West Hartford, Connecticut

"CLAUSING 6300-SERIES 12¾" lathes are the best values on the market!" — FLYNN MANUFACTURING CO., Detroit

HERE'S PROOF OF PERFORMANCE...

"Without question, Clausing 6300-Series 12¾" Lathes give you more for the money than any lathe of comparable size or price. We especially like their heavy construction which enables us to take deeper cuts, and hold tolerances better on repetitive operations." This statement by Bill Rogie, Flynn Manufacturing Co., is typical of the reports we receive from Clausing owners everywhere. Here are a few of the reasons why:

Flame hardened bedways are standard equipment *at no extra cost*. Headstock, apron and quick-change box are totally enclosed and gears and shafts *travel in bath of oil* — another important exclusive. Spindle is forged steel with 1⅝" bore, hardened and ground ASA — L-00 tapered key-locked nose. Spindle turns on Timken "Zero-Precision" tapered roller bearings. Tail stock has No. 3 MT ram. Accuracy is *verified* by test report with each lathe.

Compare *all* the features. Compare price. See for yourself why Clausing is acclaimed the outstanding lathe value — *the* lathe for *your* shop.

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the optimum arrangement of the gears. Numerous illustrations supplement the written word, and examples show the practical application of the method to standard practice, and also how to arrange compromises to suit different methods of construction.

•

INTRODUCTORY GRAPHICS—*By J Norman Arnold, Professor of Engineering Graphics, Purdue University. Published by McGraw-Hill Book Co, 330 W 42nd St, New York 36, N Y. 534 pages. Price $7.75.*

Parts of this basic mechanical-drafting book are coordinated with 16-mm black-and-white sound films produced by McGraw-Hill Text-Film department. Orthographic projection, pictorial sketching, sections and conventions, selection of dimensions, oblique cones and transition developments, and simple developments are the subjects covered both by movies and the book to provide complete classroom instruction.

The book covers drafting instruments, lettering, multiview drawing, pictorial drawing, and freehand sketching. It is an engineering-drawing text for beginning college students, but it also includes vectors, schematics, graphic equations, and graphic solutions of problems.

Thus, conventional three-view drawing is adequately covered, and the book includes valuable material on more advanced uses of graphics —maps, graphic calculus, and graphs for statistics and forecasting.

"I've had lots of experience—three days with Dill's Tack & Bind, a week with Timmin's Tool & Grund, two days with Acme Lead & Zinc, one hour with Ev's Chuck & Drill . . ."

another Bath Tap job well done . . . for

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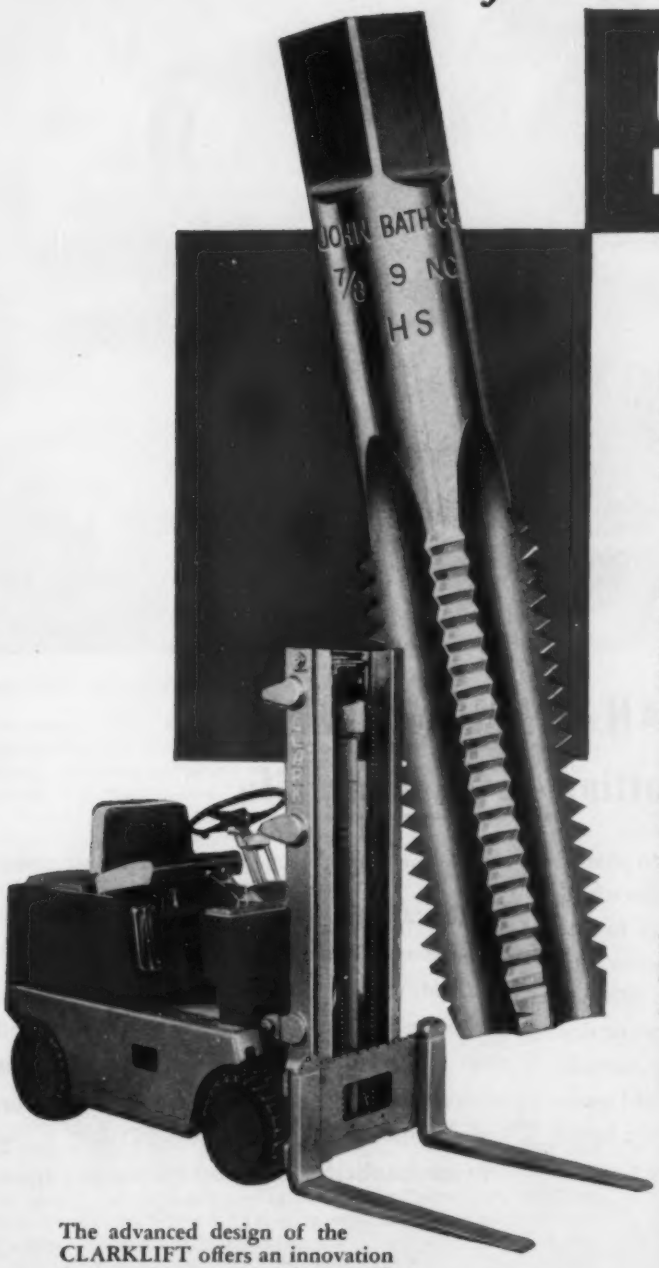

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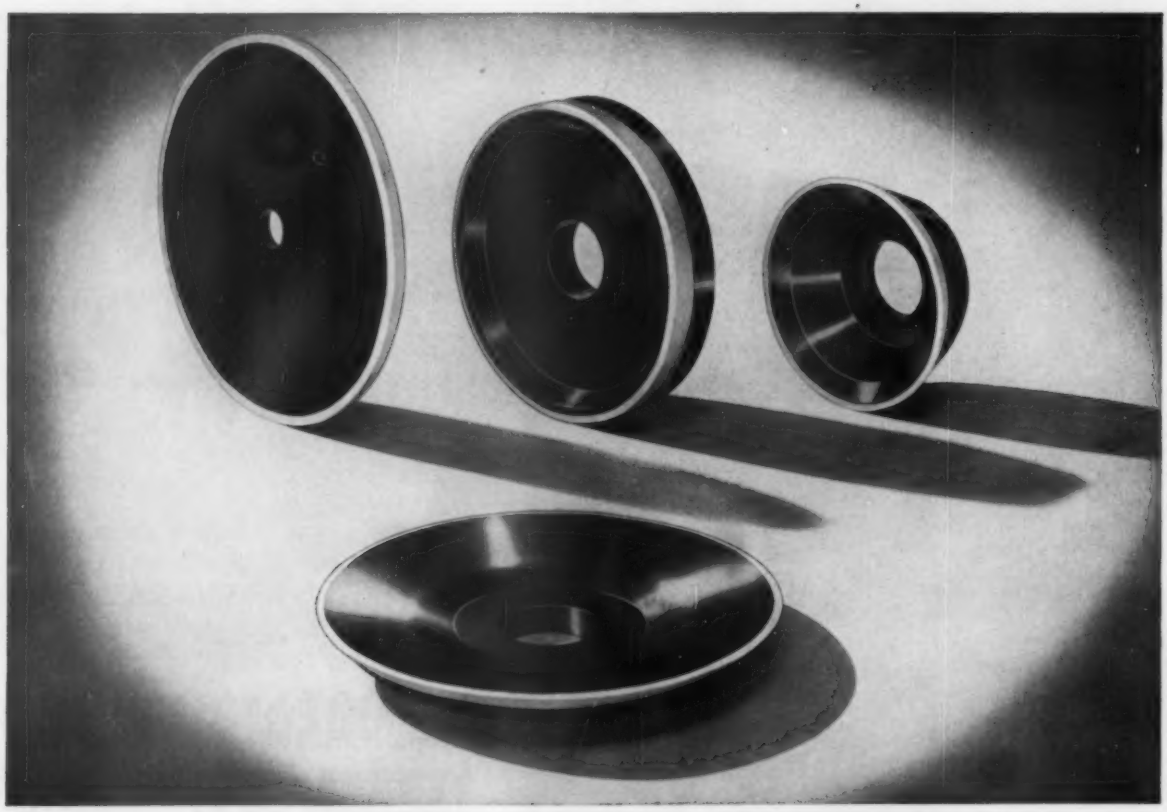

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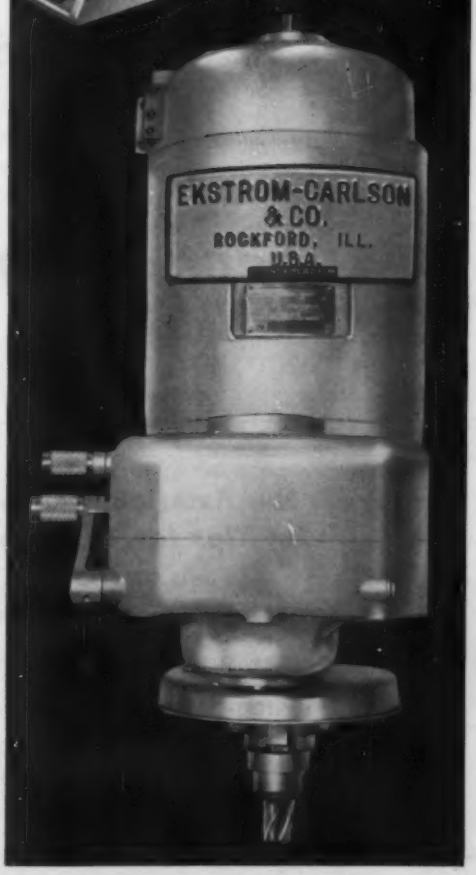

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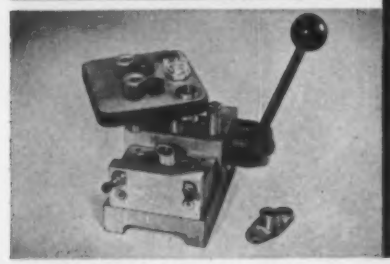

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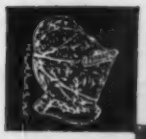
Why do dies need less maintenance in the Wean "Flying Press"?

Before answering the question, perhaps we'd better establish the fact: firms which have conducted comparative die life tests report that significant savings have been achieved with the "Flying Press." One company reported a 36% monthly reduction in die maintenance costs, noting that part production between die grinds on one run was increased from 4,000 to 123,000 pieces. Another "Flying Press" user reported that dies which had previously required repair every three weeks in a conventional press ran for a year with only one grind in the "Flying Press" . . . and turned out over 1 million parts!

The answer to this cost-cutting aspect of "Flying Press" operation lies in its unique design. Since the dies are in motion in the "Flying Press," they operate at a lower temperature than in conventional presses. Another factor is the higher punching velocity inherent in the "Flying Press" design, with its 600 strokes per minute top speed. Other "Flying Press" features . . . such as its lower bed suspension system which minimizes side thrust on the gibs, and its dynamic balance . . . also contribute to longer die life and sustained accuracy of press adjustment.

Finally, dies are protected against damage by the protective devices built into the "Flying Press" to detect "cobbles" and prevent double hits. And the "Flying Press" uses standard dies, so there's no special expense involved in its tooling.

Operating economy is just one more reason that you should investigate this outstanding piece of metalworking equipment if your plant uses stamped parts in quantity. We'll be happy to send you literature or arrange an appointment for a Wean sales representative to discuss the potential of the "Flying Press" for your specific production operations. May we hear from you?



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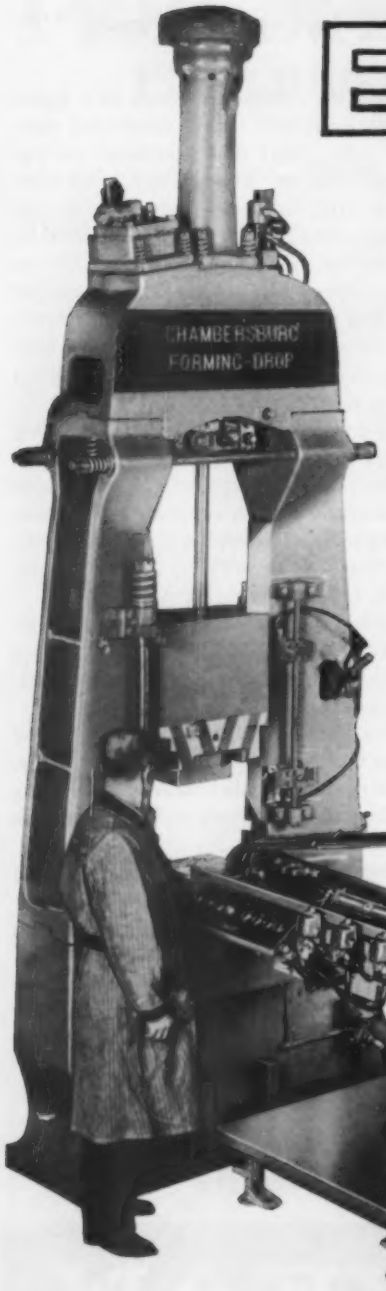

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The new Chambersburg Forming Drop meets the demand for an accurate, high production hammer for coining, embossing, forming and cold striking. The impact blow, which minimizes springback, can be precisely adjusted to suit particular job requirements. Electric controls permit the use of versatile feed devices increasing operator safety and efficiency.

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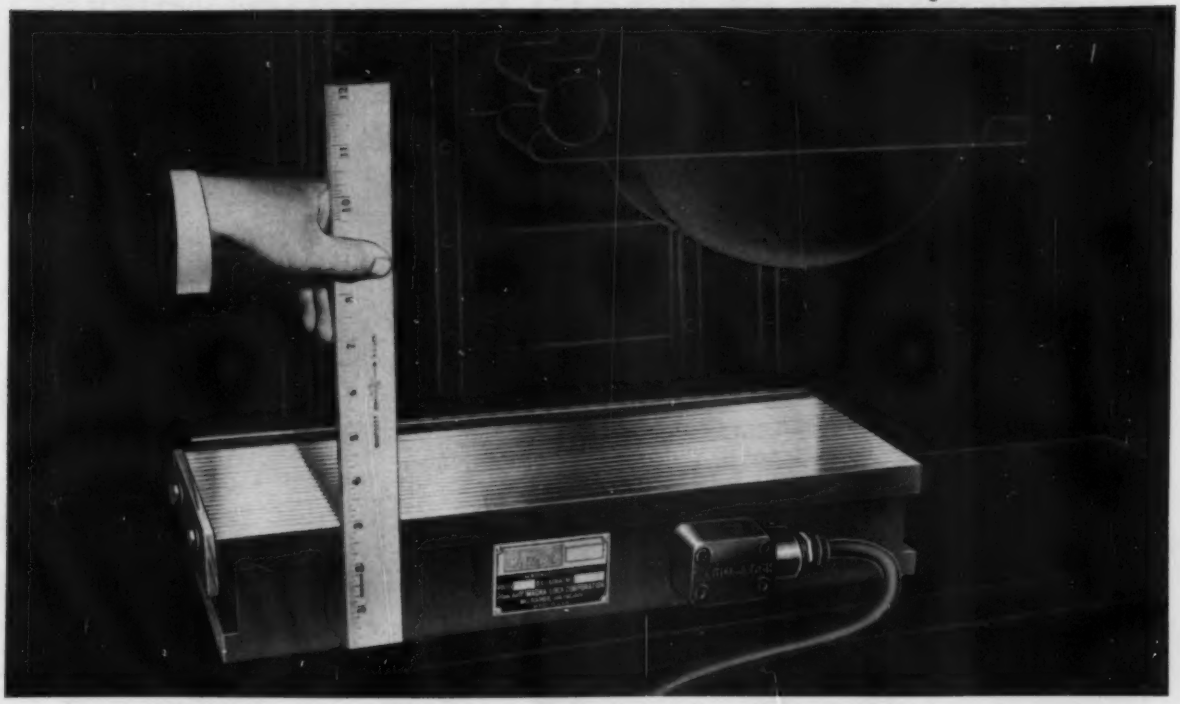

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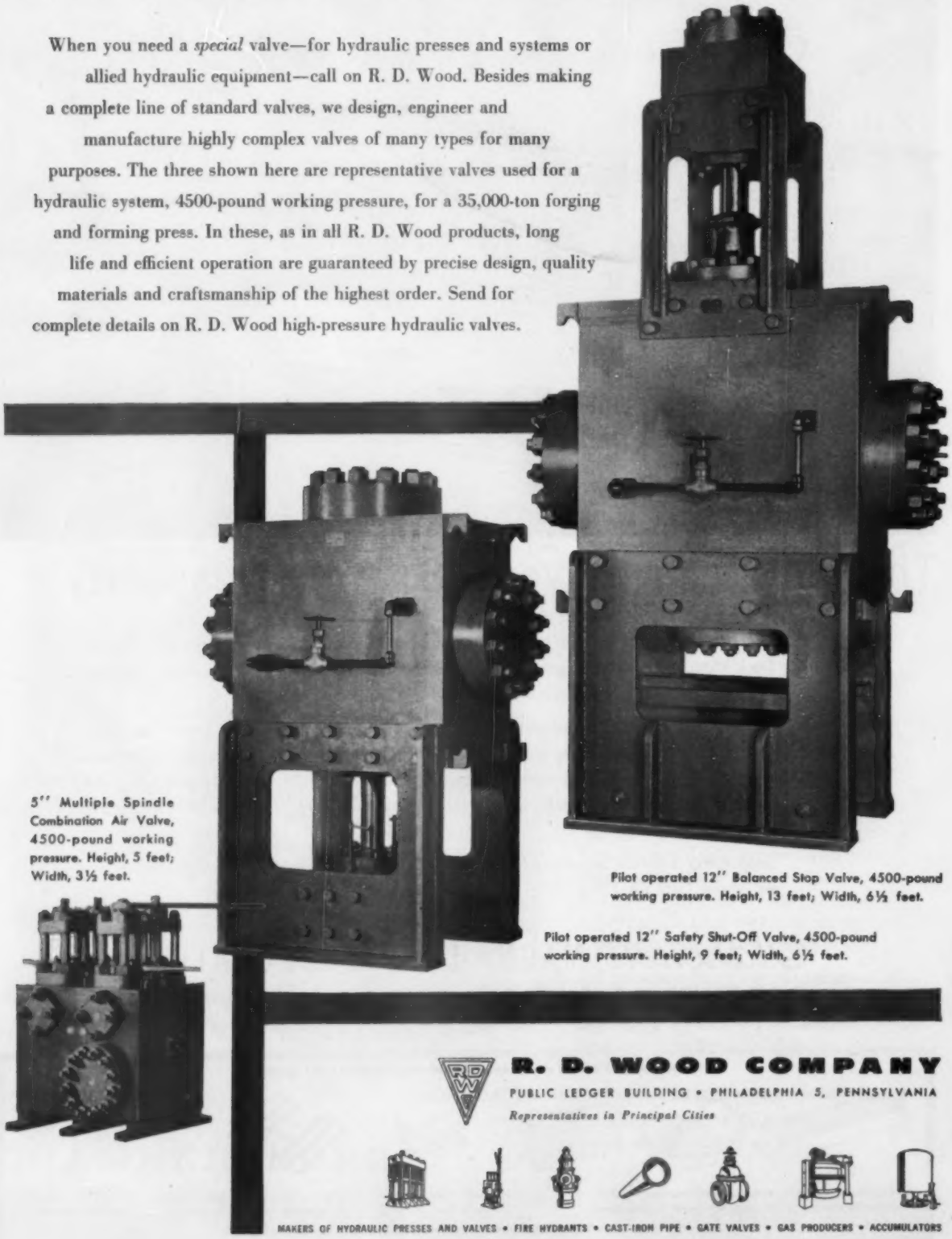

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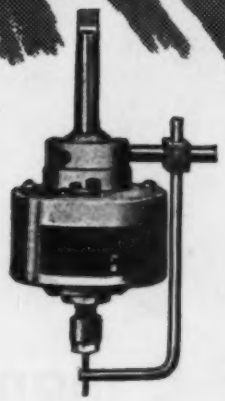

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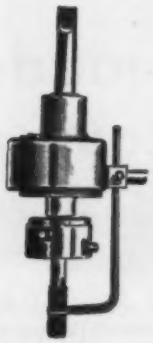
Designed for Ball Bearing High Speed Drill Press.



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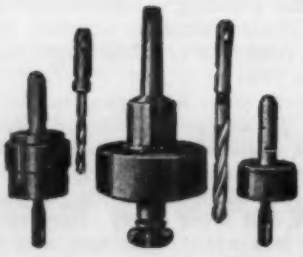

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These Tappers may also be adapted for button or acorn die threading.

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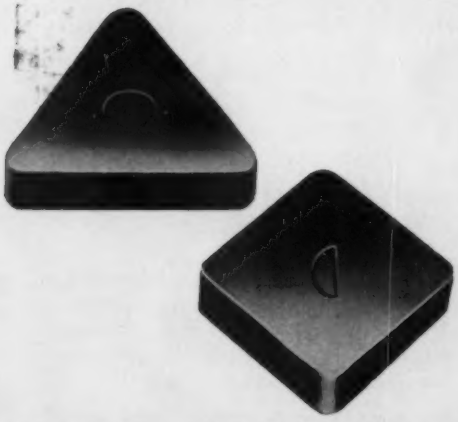

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Tool Steel Topics

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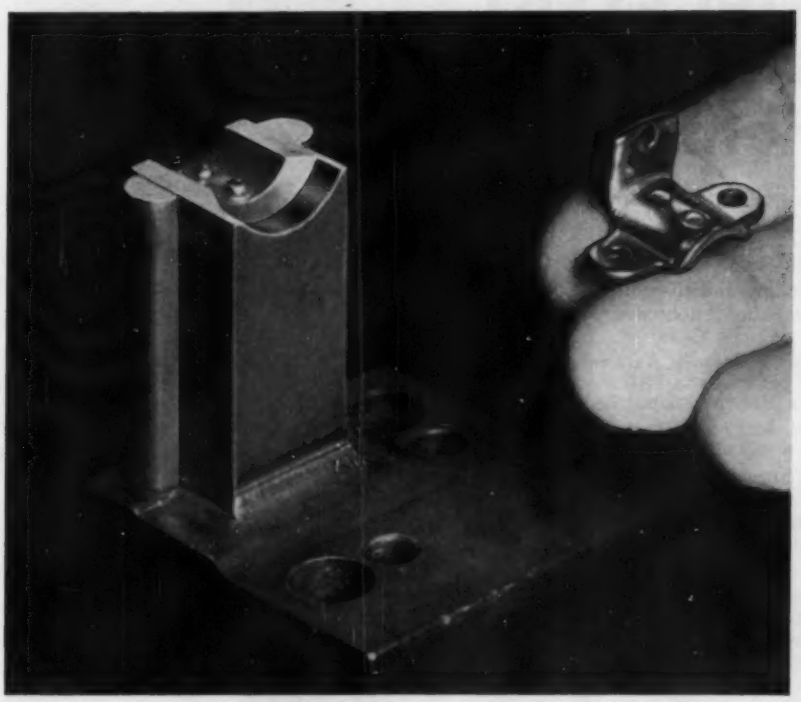


1½ million pieces with Lehigh H ...that's a long run in any league!

At Harvey Hubbell, Inc., Bridgeport, Conn., they were using a competitive grade of tool steel to form cord-clamp sections made from Grade 1010 steel strip. But each time they hit an average figure of 700,000 pieces, the die cracked, and had to be replaced. The manufacturer decided to call in Lindquist Steels Inc., a local distributor of Bethlehem tool steel.

"With the finished part only .060 in. thick, we ought to do better than 700,000 pieces. What do you suggest?"

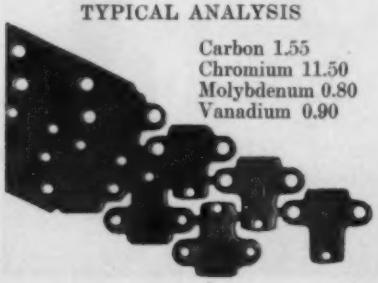
The distributor studied the operation, the cracked die, and the finished part. "I'd recommend Lehigh H," he said. "It has the strength you need in a forming operation of this sort." The Lehigh H was put on the job and produced 1½ million pieces without any trouble.

Lehigh H is our high-carbon, high-chromium, air-hardening tool steel. It's a grade with outstanding wear-resistance and toughness. And it's also a deep-hardening steel with high compressive strength.

The best way to evaluate Lehigh H is by putting it to work—not in an easy job, but in a tough one. Your Bethlehem tool steel distributor carries Lehigh H in stock, and will see that it's delivered promptly. Get in touch with him.

TYPICAL ANALYSIS

Carbon 1.55
Chromium 11.50
Molybdenum 0.80
Vanadium 0.90



BETHLEHEM TOOL STEEL ENGINEER SAYS:

Don't Use Fresh Water For Quenching Tools

Fresh water, regardless of its source, contains dissolved gases which make it unsuitable for quenching tools. When tools are quenched in fresh water, gas is liberated at the surface of the tool. Gas pockets thus formed may prevent contact between tool and water, resulting in soft spots from ineffective quenching. Soft spots are undesirable because of their low hardness, and also because a quench which produces them may also cause cracking of the tools.

Soft spots, and tool cracking associated with soft spots, can be avoided by quenching in water which has been previously boiled, to remove the dissolved gases. If water cannot be boiled, quench a large amount of hot "dummy" material to expel the gases. As a further precaution against soft spots, it is preferable to use a 10 pct brine solution instend of water. It is also suggested that the dissolved gases be expelled from the brine solution before use.

USE DURAMOLD FOR COLD-HOBBING

Bethlehem's Duramold tool steels, in Grades A and B, are ideal for cold-hobbing plastic dies because they are free from injurious surface and internal defects. Duramold A, an air-hardening grade, is annealed to 109 max Brinell. Duramold B hardens in oil, and hobs more readily than Duramold A. It is annealed to 100 max Brinell, and has an addition of boron to increase the core strength.

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Superficial—for extremely shallow indentations.

Twintester—combines functions of "ROCKWELL" and "ROCKWELL" Superficial testers.

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ALL WILSON "ROCKWELL" hardness testers provide these advantages:

Accurate performance—precision built, with exact calibration, for consistently correct results.

Long life—durable as a machine tool.

Easy operation—even an unskilled operator can get perfect readings. All controls conveniently grouped.

Easy maintenance—interchangeable mechanisms, with spindles mounted on oil-less bearings.

DIAMOND "BRALE" PENETRATORS

for perfect testing every time

A perfect diamond penetrator is essential to accurate hardness testing. Since one point of hardness on the "ROCKWELL" scale represents only 80 millionths of an inch of penetration—only 40 millionths on a Superficial tester—the slightest imperfection will cause a false reading.

Only *perfect* Wilson Diamond Brale Penetrators are sold. Each diamond is flawless, with no chips or cracks. It's cut to an exact shape. Microscopic inspection and a comparator check of every diamond—one at a time—assure this perfection—and assure you of accurate hardness testing every time.

A COMPLETE LIBRARY of Helpful Information

A wide variety of bulletins tells about hardness testing, and describes the many instruments, accessories, and services Wilson offers. Write for your choice:

DH-325—WILSON "ROCKWELL" Hardness Testers • **DH-326**—"ROCKWELL" Superficial Hardness Testers • **TT-58**—"ROCKWELL" Twintester • **DH-327**—Special "ROCKWELL" Testers, including Automatic and Semi-Automatic models • **DH-328**—TUKON Tester, for precision MICRO and MACRO testing

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MECHANICAL INSTRUMENT DIVISION

AMERICAN CHAIN & CABLE

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olivetti

high-precision grinding machines with hydraulic automatic infeed for traverse grinding and plunge grinding as standard equipment on all models.

3 types:

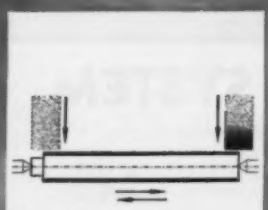
UNIVERSAL. *Swivelling wheelhead, internal grinding attachment, infinitely variable speed headstock.*

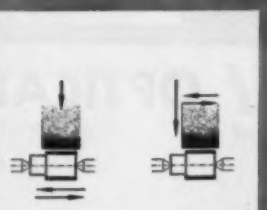
PRODUCTION. *Larger grinding wheel, more horsepower, non-swivelling wheelhead, 8-speed headstock.*

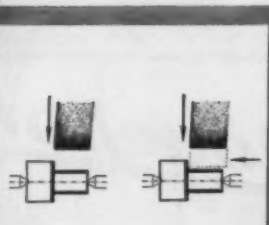
PLUNGE. *Similar to production type but with axially oscillating wheelhead and hand table control only.*

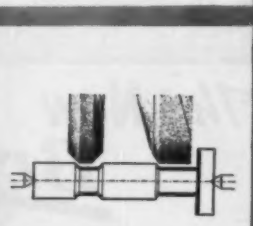
4 sizes:

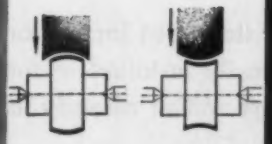
10", 12", 14", and 18" swings (with choice of lengths between centers).











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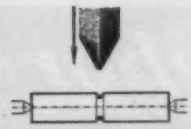

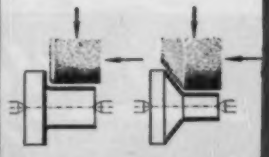

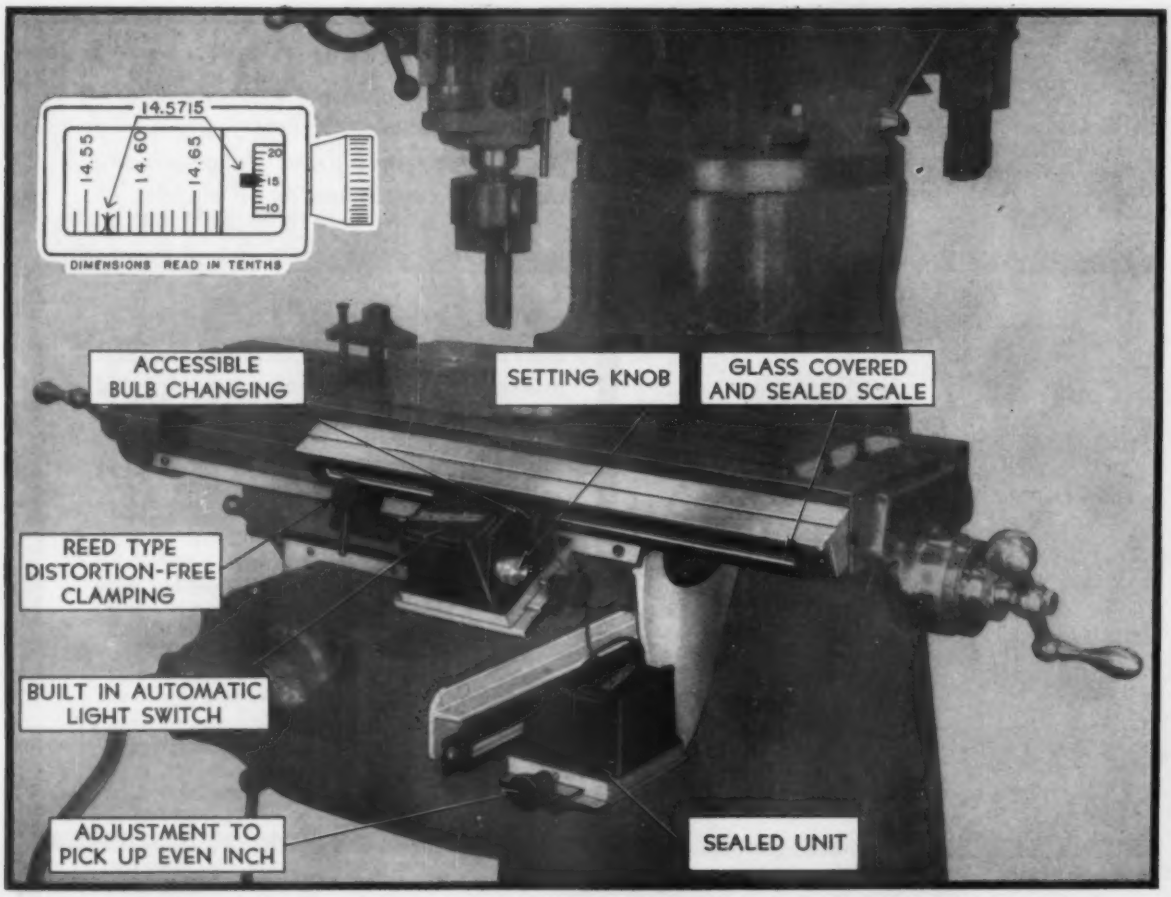

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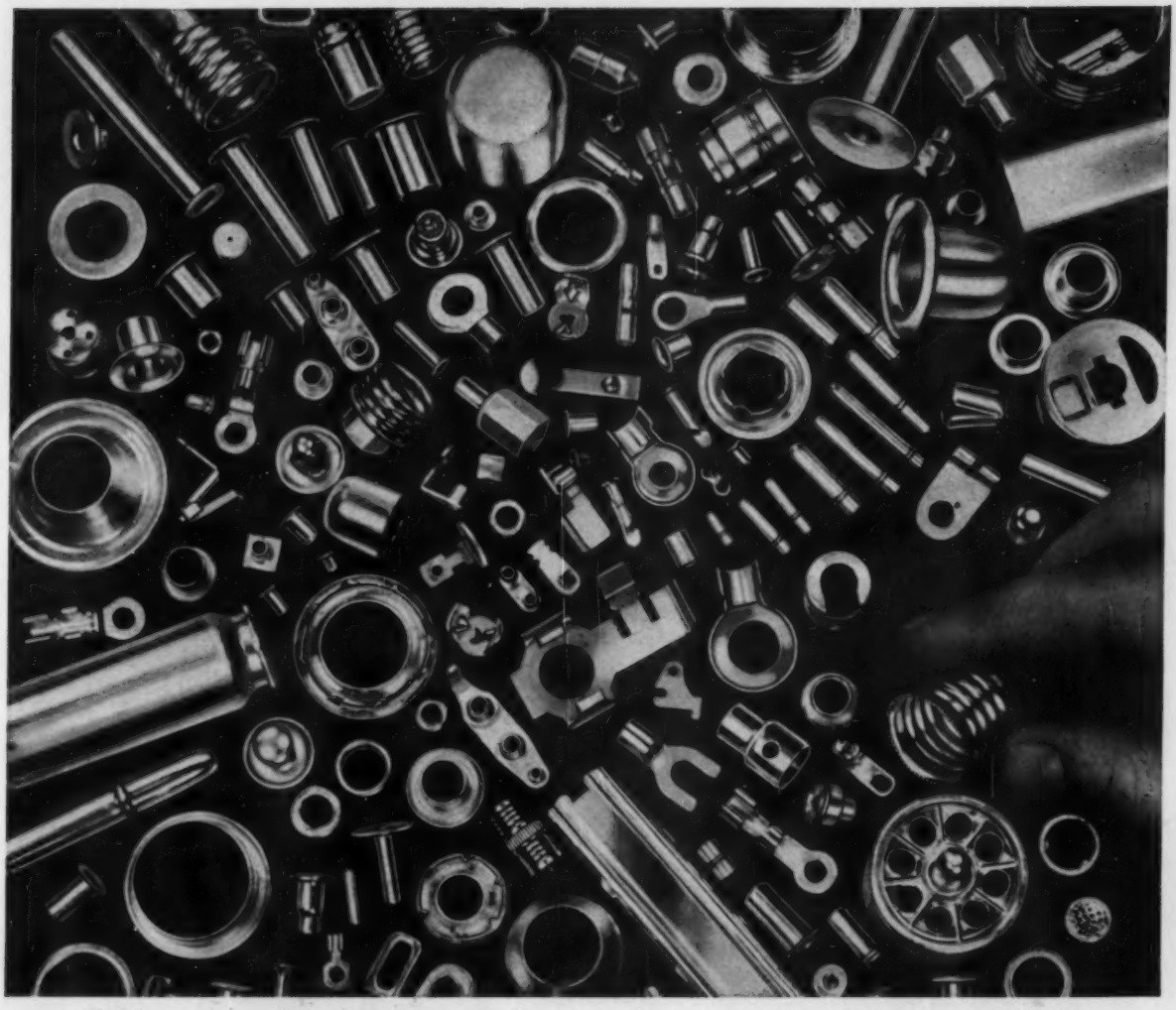

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TRIANGULAR PRECISION-GROUND NEGATIVE RAKE	TB-12P22	3/8		1/8	1/32	AS PER CURRENT ADAMAS CATALOG	☐
	TB-12P32	3/8		3/16	1/32		☐
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	TB-16P32	1/2		3/16	1/32		☐
	TB-16P33	1/2		3/16	3/64		☐
SQUARE PRECISION-GROUND NEGATIVE RAKE	SQ-16P22		1/2	1/8	1/32		☐
	SQ-16P32		1/2	3/16	1/32		☐
	SQ-16P33		1/2	3/16	3/64		☐
	SQ-24P32		3/4	3/16	1/32		☐
	SQ-24P33		3/4	3/16	3/64		☐
	SQ-24P34		3/4	3/16	1/16		☐

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automated turret lathe with air-hydraulic cross slides

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Spindle and turret control panel

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- **Automatic cycling**
- **Adjustable rapid travel**
- **Variable-rate turret feed**
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- **Variable-speed drive**
- **Pushbutton control**
- **Available as bar-feed machine**
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Only the Logan Logamatic 410 offers so many features in its price range! Swing over bed, 14⅝". Swing over cross slide, 6⅞". Spindle bearings: (4) ABEC Class 7. Speed range, 25 to 2,000 rpm. Two-speed, 3-1½ hp. Dinabrake motor & controls: standard equipment.

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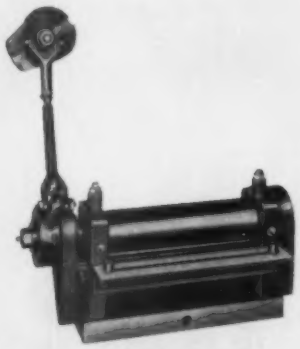
Supplies a slack loop from which any machine can freely draw; puts more footage through any machine, eliminates heavy lifting.



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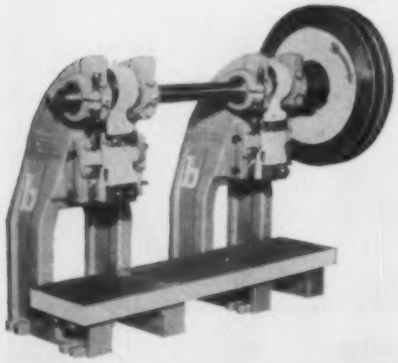

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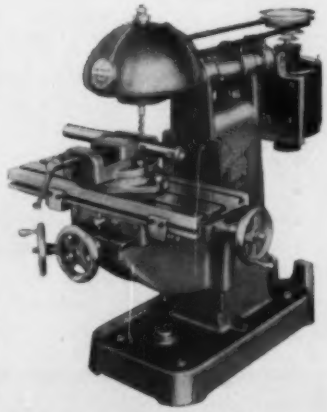

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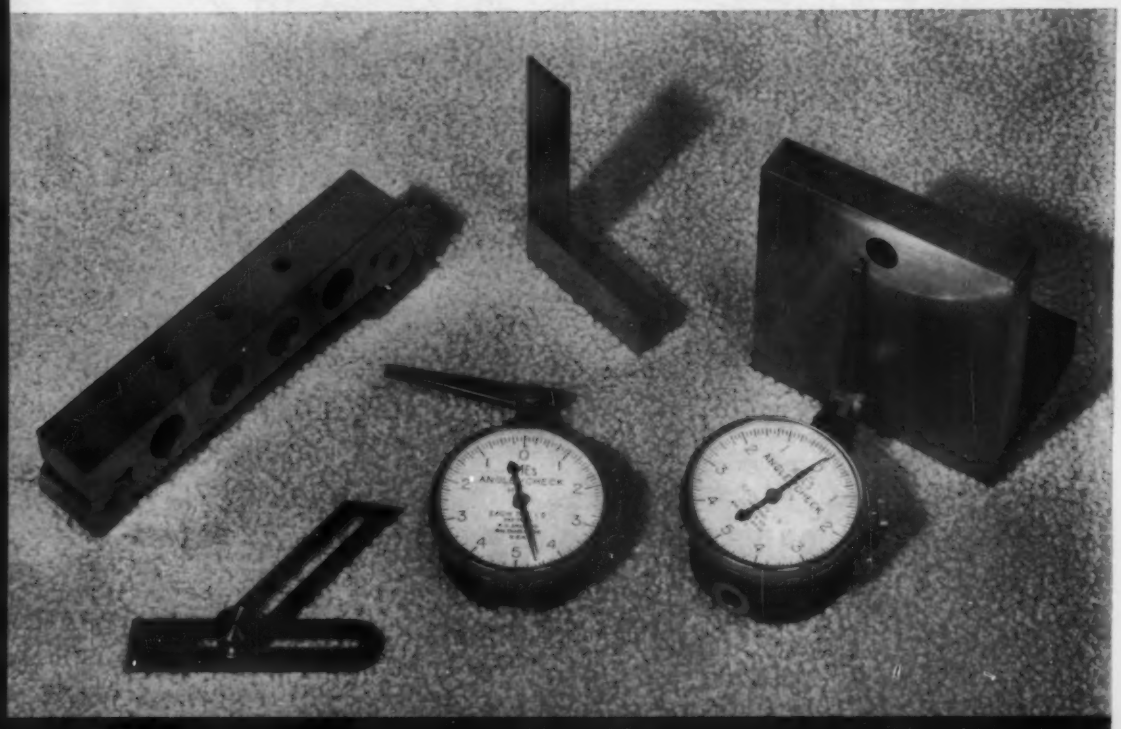

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The contact blade can be set simply and quickly without tools to a predetermined angle with the dial "0" under the indicator hand. A range of 10°—from 5° minus to 5° plus—in increments of 5′ can be obtained. ANGLE CHECK is accurate to 5′. Write today for complete information.

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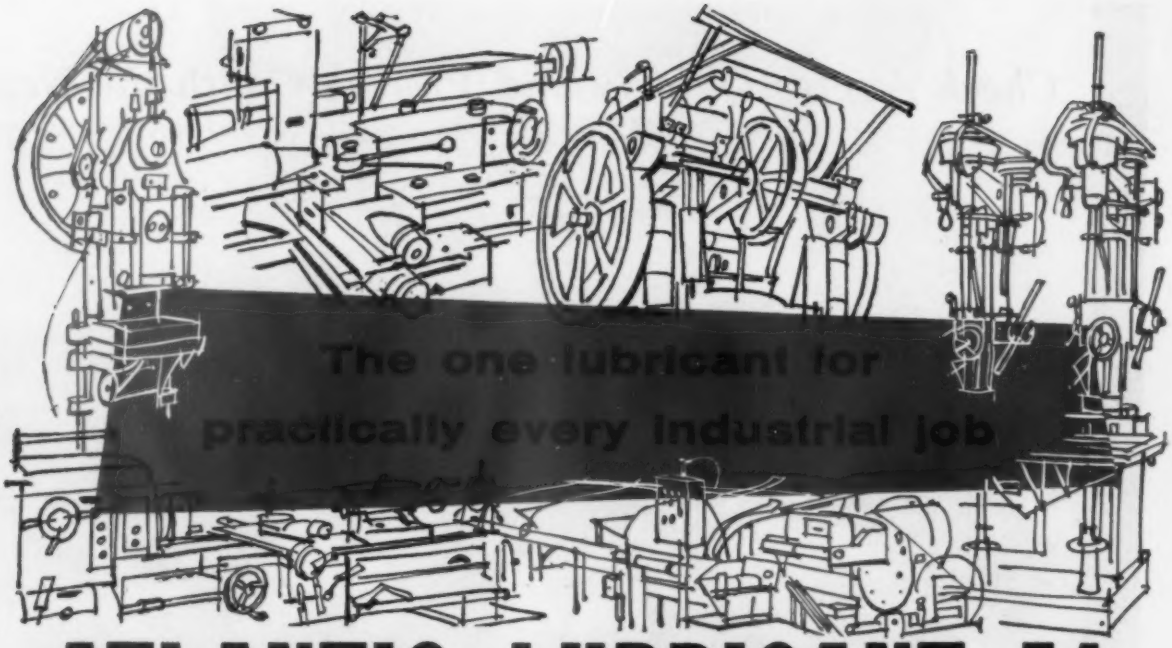
CIRCLE 393 READER SERVICE CARD



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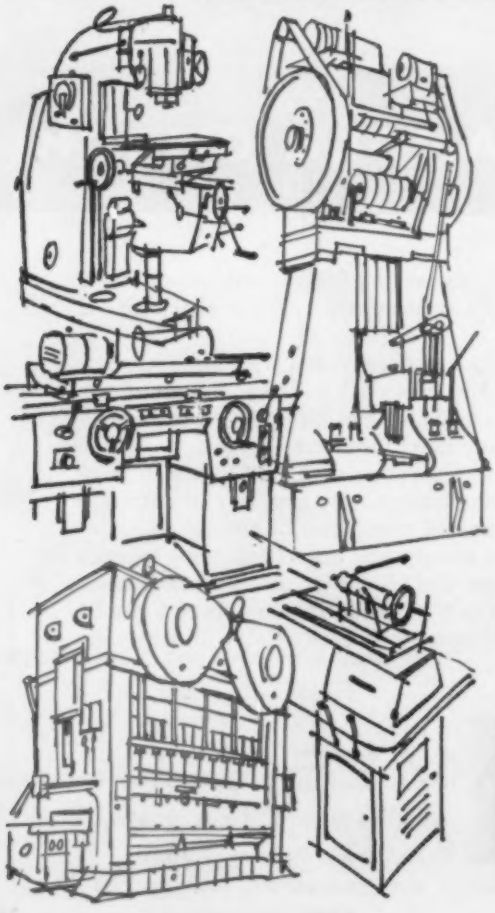
Performs on all types of grease-lubricated machinery • Cuts cost • Reduces lubricating errors



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The W-T Radial Drill is made in 24 models with your choice of 4¼" or 6" spindle travel.

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Because the drill head moves to the work, this new W-T "Light-Heavyweight" offers unusual versatility and flexibility—provides a fast, efficient means for drilling a number of holes in heavy or bulky pieces, with a minimum of set-up time.

The ram has a big 18" travel radius which allows drilling to the center of a 62" circle; the head, ram and cradle swivel 360° around the column for drilling anywhere on the table or for drilling large pieces that must be kept on the floor; the head tilts and securely locks 45° right or left; and the built-in ball bearing jack shaft assembly provides 15 speeds from 160 to 8300 rpm.

A demonstration will prove to you why this new Walker-Turner Radial Drill is better than ever before.

USE WALKER-TURNER RADIAL DRILL HEADS, with or without jack shaft assemblies, for flexible automation set-ups and other special applications.

Ask your W-T distributor to show you the many outstanding advantages of this new line of "Light-Heavyweights." He's listed under "Tools" in your telephone directory.

MAIL COUPON FOR COMPLETE DETAILS!

WALKER-TURNER
Division of Rockwell Manufacturing Co.
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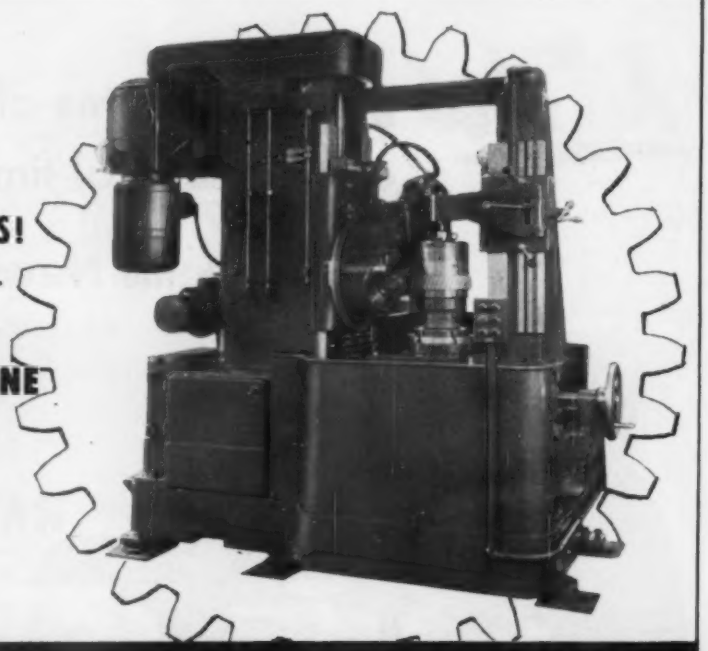
RUGGED...AND READY TO HOB YOUR HEAVY-PITCH GEARS!

The New Lees-Bradner

MODEL R MARK II, 16" x 18" HOBBING MACHINE



After three years of development work, we're proud to announce the introduction of the new Lees-Bradner Model R Mark II, 16" x 18" Heavy Duty Hobbing Machine. The Mark II is designed to generate gears for trucks, earth-moving machinery, tractors and other equipment where heavy-pitch gears are required.

Features include optional refinements such as a lead differential and a power infeed unit for hobbing worm wheels.

See your Lees-Bradner distributor or write the company direct for additional information on this efficient new machine.

Standard equipment: 6" manual hob shift
To order: 6" electric hob shift

the LEES-BRADNER Company

CLEVELAND 11, OHIO • U.S.A.

CIRCLE 396 READER SERVICE CARD

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Taps nuts and screw machine parts automatically to close tolerances. Produces smooth, clean threads square to nut bearing surface. Maintains high production with minimum tapwear. Safety devices prevent tap breakage. Complete information available on request.

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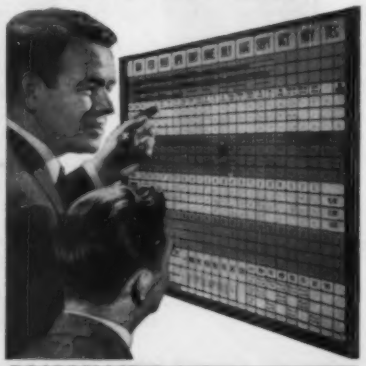
How To Get Things Done Better And Faster



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7. Costs less for make-up since only water is added.
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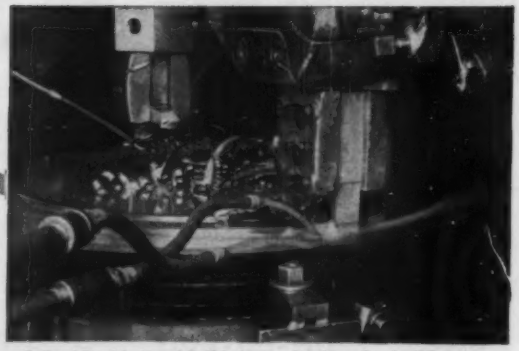
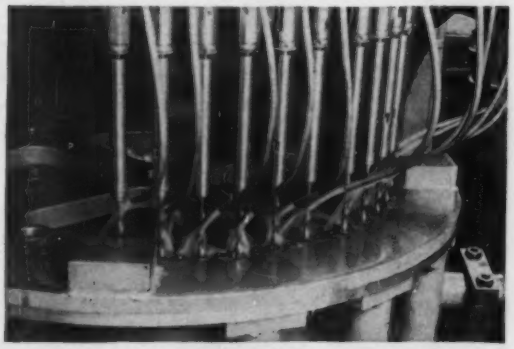
HAMIKLEER dissolves instantly in any water to make a clear, thin solution that can be made more dilute than is practical for ordinary soluble oils. The solutions are more efficient at the longest range dilution . . . as proved by years of experience on many different metalworking operations.

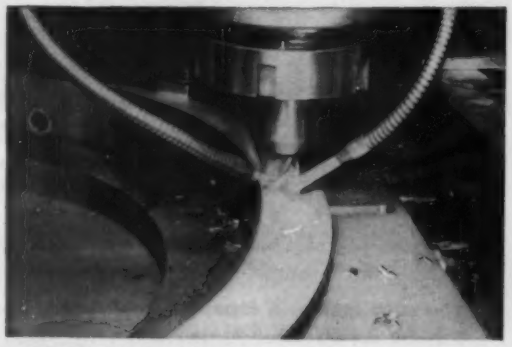
Write for a free sample to test on your own metalworking operations.



Bullard-Double Head Self-Indexing Machine. Stock: 410 stainless; Tools: carbide tips, both rough cuts; RPM: 40; Feed: .016; Micro Finish: 61; HAMIKLEER Dilution: 1:50.



Bausch Multiple Drill Press. Tool: High Speed Steel; Stock: 316 and 410 Stainless; RPM: 400; Feed: .003; Tolerance: ± .005 Micro-Finish: 125 (without reaming); HAMIKLEER Dilution: 1:50.



Cincinnati Hydrotel Contouring Machine. This is a milling operation, end cutting scallops. Tool: High Speed Steel, 3 flutes high; RPM: 200; Feed: 3"; Depth of Cut: .530; Micro Finish: 61; HAMIKLEER Dilution: 1:50.

This free test kit is sent to all HAMIKLEER users. It permits operators to test dilution right at the machine, saving considerable time.

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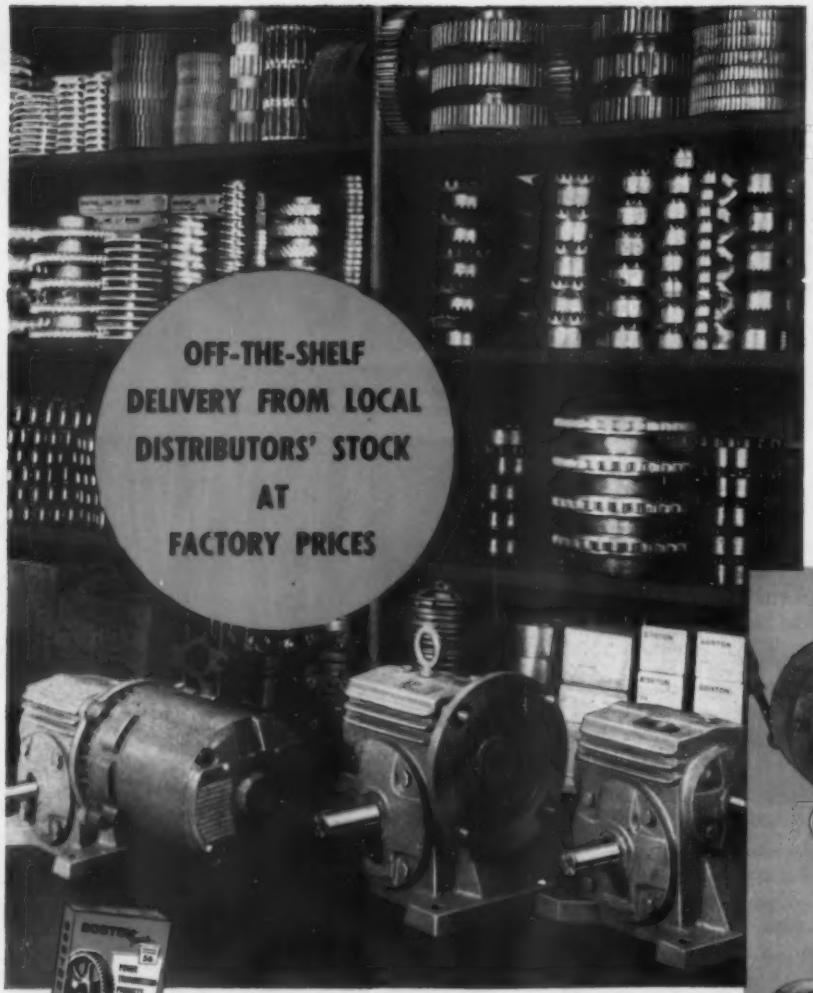

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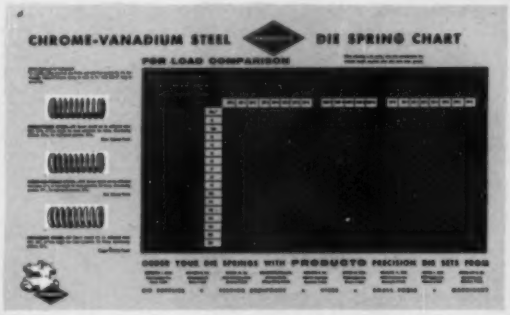
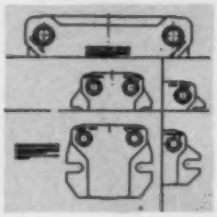


Die Spring Comparison Chart

Die spring selection is simplified by this 12" x 20" chart in two colors, suitable for wall mounting. Convenient for use at the drawing board, bench or in the stockroom. Covers all three series of Producto chrome-vanadium die springs: Medium-pressure 50% deflection, Medium high-pressure 37% deflection, and High-pressure 30% deflection. Free.*

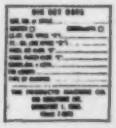
Die Set Digest

Every issue of this 8-page quarterly publication is packed with valuable hints for designers, manufacturers and users of dies. Hard-to-find information is presented clearly in the *Digest:* "Die Set Maintenance in the Pressroom"; "How to Select and Use Die Springs"; "How to Lubricate for Longer Life". Write and ask to receive *Die Set Digest* regularly. No charge.*



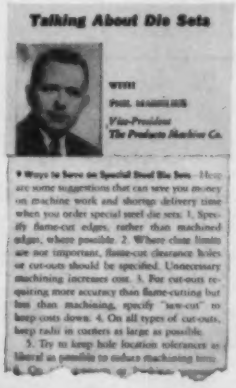
Die Set Templates

Accurate full-size templates for Producto rear-pin die sets. Save time and simplify layout for the busy die designer. $3.50 set. Write today.



Die Set Specification Stamp

Rubber stamp for tracings, prints. Provides spaces for die set ordering information. Free.*



Ad Reprints

Valuable die set know-how is provided in recent "Talking About Die Sets" columns: *How to Save on Steel Specials, Steel vs. Semi-steel,* and others. Send for complete file, free.*

*WRITE TODAY for these useful and informative diemaking aids. Requests on company letterheads will be filled promptly.

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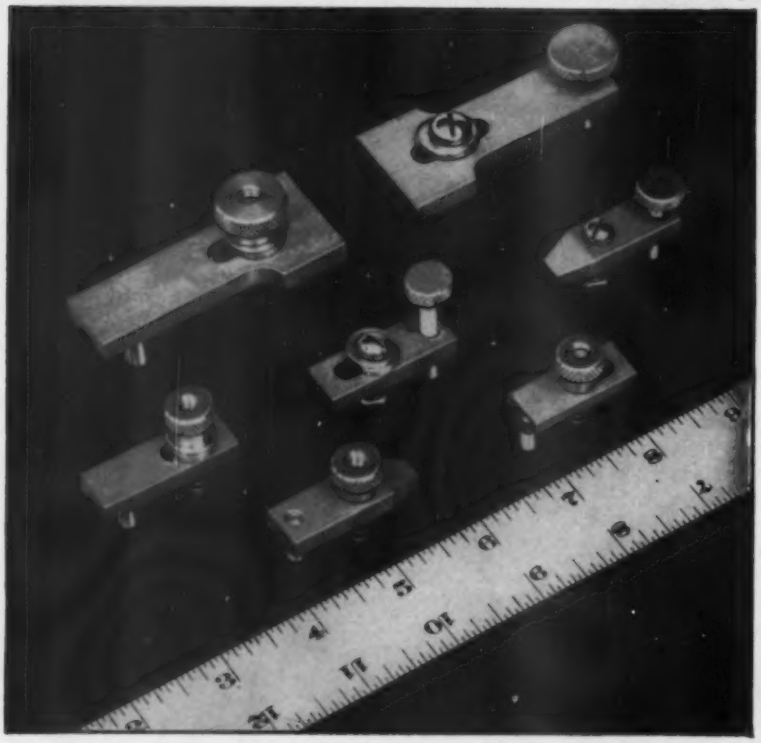

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Adoption of these new Torque Control Angle Wrenches expands I-R's line, making it the most complete on the market. Unique feature is automatic torque control valve which shuts off air to the motor when nut is run to pre-determined torque.

Built in torque control is a feature of this I-R size 38PT. Torque ratings range from 5 to 100 ft. lbs.

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Easiest way for you to cut production costs and increase man-hour output is with new, more efficient air tools. Tools shown here are representative of the more than 200 new, more productive tools added to the I-R line in the past two years. Power increases ranging up to 75% help to cut costs on fastening operations.

For detailed information about the complete I-R line of cost-cutting Air Tools—call or write your nearby I-R office.

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Tools plus AIRengineering increase output per man

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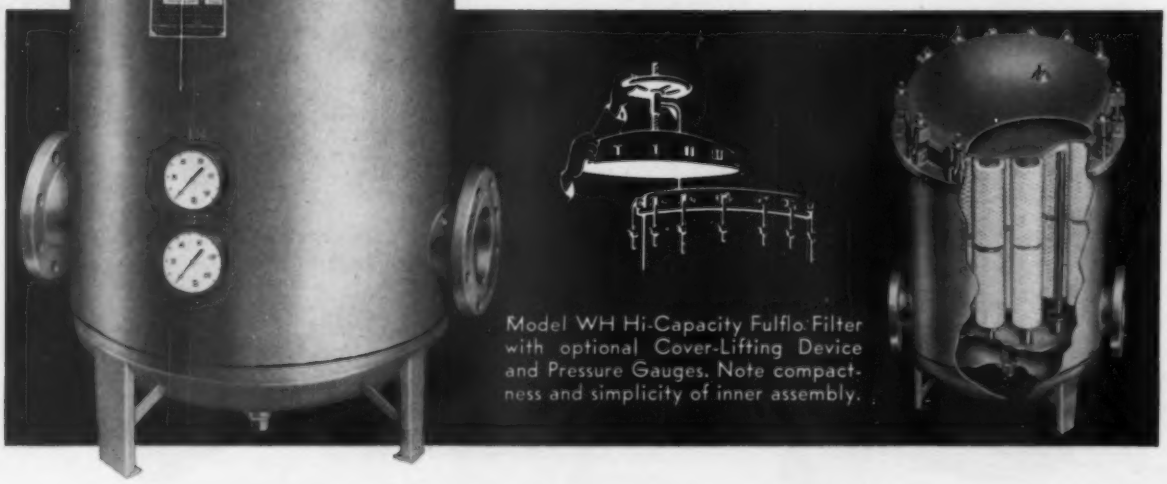

Model WH Hi-Capacity Fulflo Filter with optional Cover-Lifting Device and Pressure Gauges. Note compactness and simplicity of inner assembly.

The completely new Hi-Capacity Fulflo Filter brings you substantial production savings through decreased downtime and improved quality — plus *lower-than-ever initial cost.*

This compact sturdy steel filter is available in a full range of sizes — with from 24 to 270 10-inch Honeycomb Filter Tubes — for flow rates as high as 1350 gpm or more, depending on viscosity. Brand new cover is fastened by sturdy bolts which swing down when loosened to release cover for easy access to filter tubes. Optional Cover-Lifting Device enables cover to swivel aside for even speedier servicing.

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The new Model WH Fulflo Filter provides continuous micro-clarity, at minimum pressure drop, for all types of liquids and gases. Exclusive Honeycomb Filter Tubes provide true *depth* filtration through hundreds of filtering tunnels, precision engineered for uniformity of size, shape and depth. Tubes are available in a wide range of positively controlled densities and in a variety of natural and synthetic fibres.

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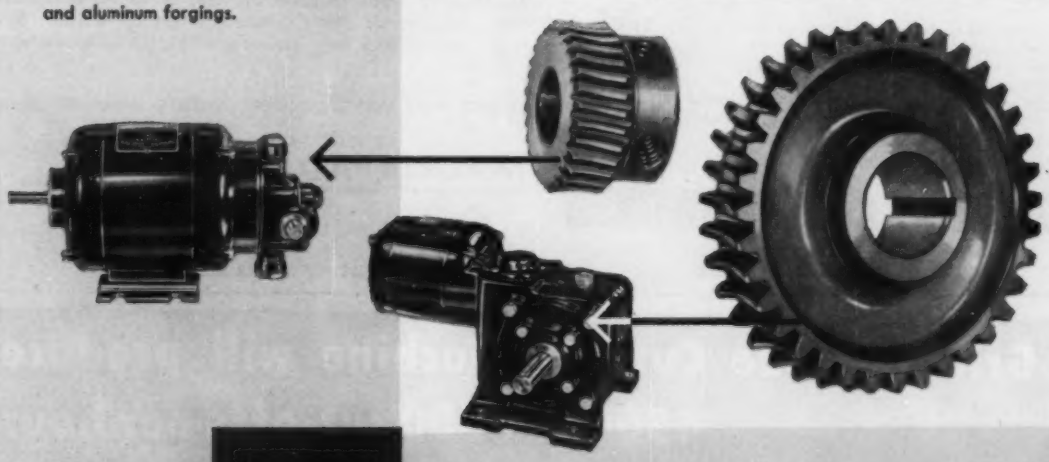

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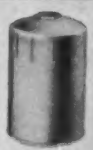

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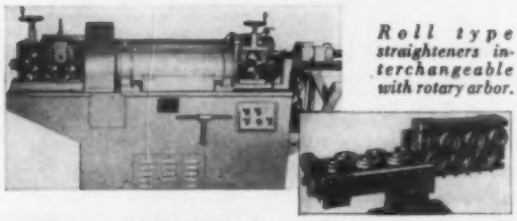

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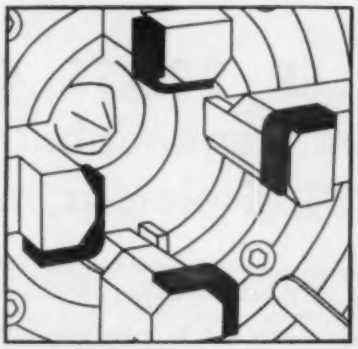

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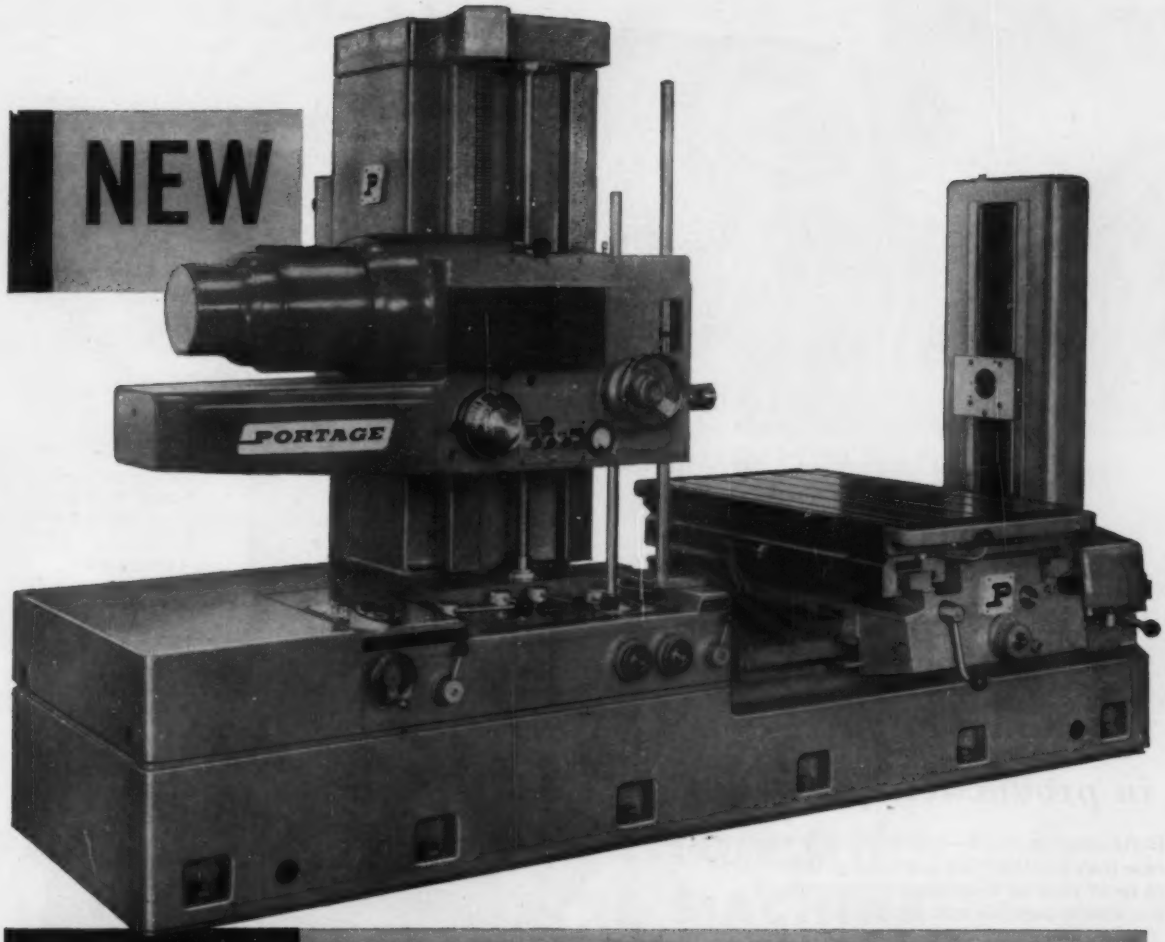

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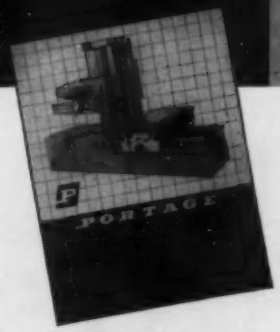

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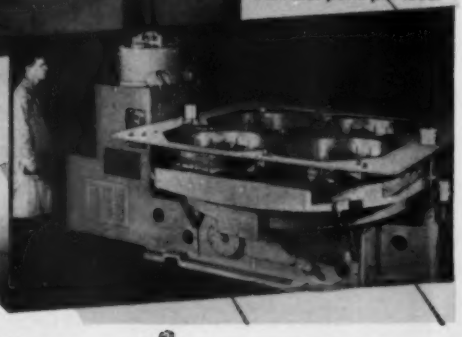

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The part is a diesel engine rocker shaft bracket. Setups for three different size parts are readily made with adjustable adaptors on the fixtures and adjustable spacers on the milling arbors. Production is 112 pieces per hour at 100% efficiency. Here's what happens at each station.

(1) Load **(2)** Drill large hole **(3)** Spot face and chamfer large hole **(4)** Ream large hole **(5)** Straddle mill top of boss and mounting face **(6)** Drill small cross hole to half depth **(7)** Drill small cross hole to full depth **(8)** Finish mill mounting face **(9)** Finish bore large hole to .0005" tolerance.

The machine features precision balanced spindles for milling and boring, a variable speed pump to power the hydraulic indexing mechanism, automatic lubrication, and J.I.C. electrical and hydraulic systems. Perhaps a similar arrangement of versatile LeMaire way-type units can simplify your production machining problem. Call or write for consultation with a LeMaire field engineer.

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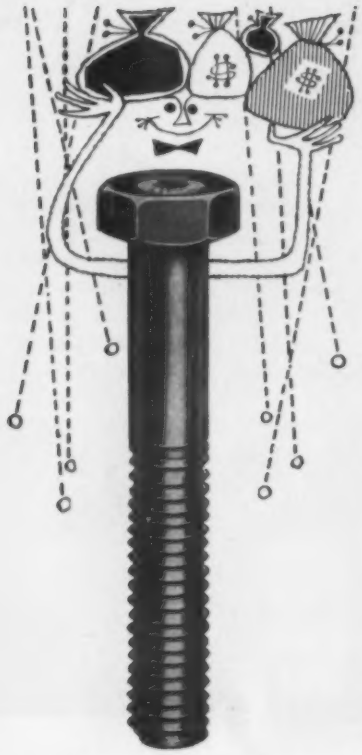

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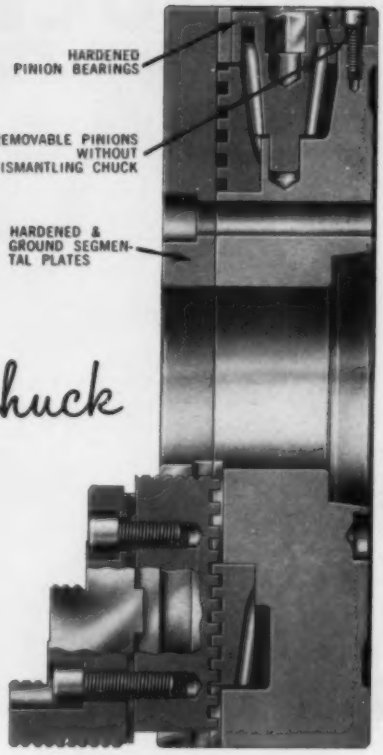


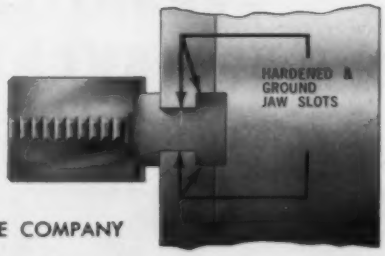
The Right chuck

FOR THE JOB!

Whiton's universal geared scroll 3-jaw chuck is the right chuck for high-precision work and long dependable service. A major improvement over the conventional chuck, it features jaw slots formed by separate plates hardened and finish ground before mounting on the chuck body.

Whiton hardened plate type chucks available from 6" to 15" diameter for American Standard Spindle Noses; Types A, D, & L. Furnished with style No. 6 American Standard Tongue and Groove type reversible jaws.

Complete technical information available on request.



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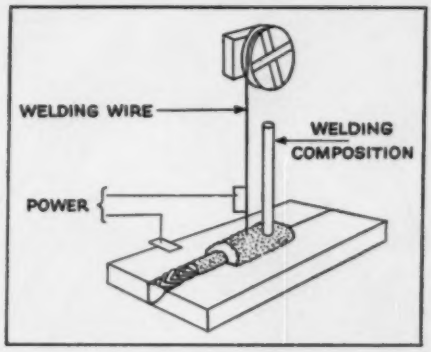
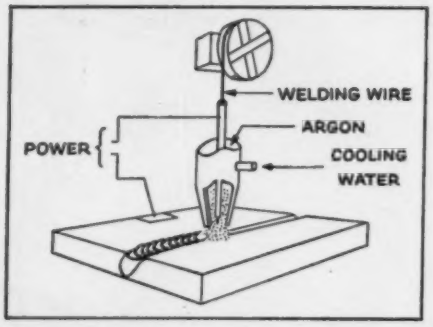
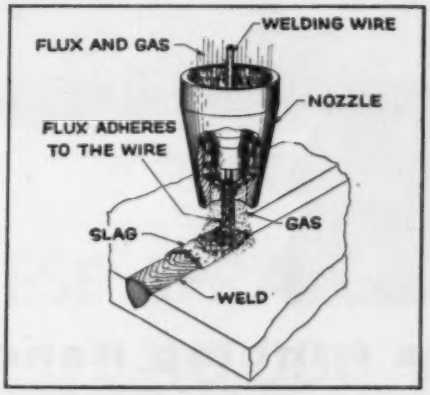
LINDE's Modern Methods for Joining Metals



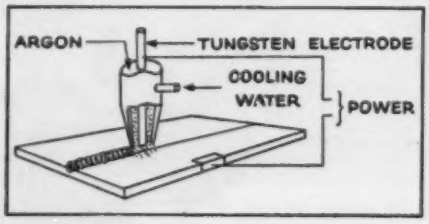
UNIONMELT Welding is a submerged arc process for high-quality electric welding at high speed of any thickness of commercially-used steel, without flash, glare, or sparks. UNIONMELT Welding equipment and supplies are available from LINDE.



Sigma Welding—A superfast, shielded inert gas metal arc method for production electric welding of aluminum, stainless steel and other metals. LINDE supplies equipment, consumable electrodes, and inert gases for Sigma welding.



UNIONARC Welding is LINDE's newest development in manual electric welding, using a magnetic flux with gas-shielded arc. UNIONARC Welding is extremely fast and economical; can be handled in all positions—vertical, overhead, downhand.



HELIARC Welding makes clean, smooth welds electrically without flux, in practically all commercial metals at high speed. HELIARC Cutting Apparatus is fast, flexible, and versatile. LINDE supplies equipment and inert shielding gas for both types of apparatus.

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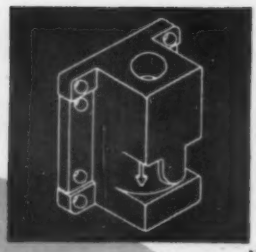
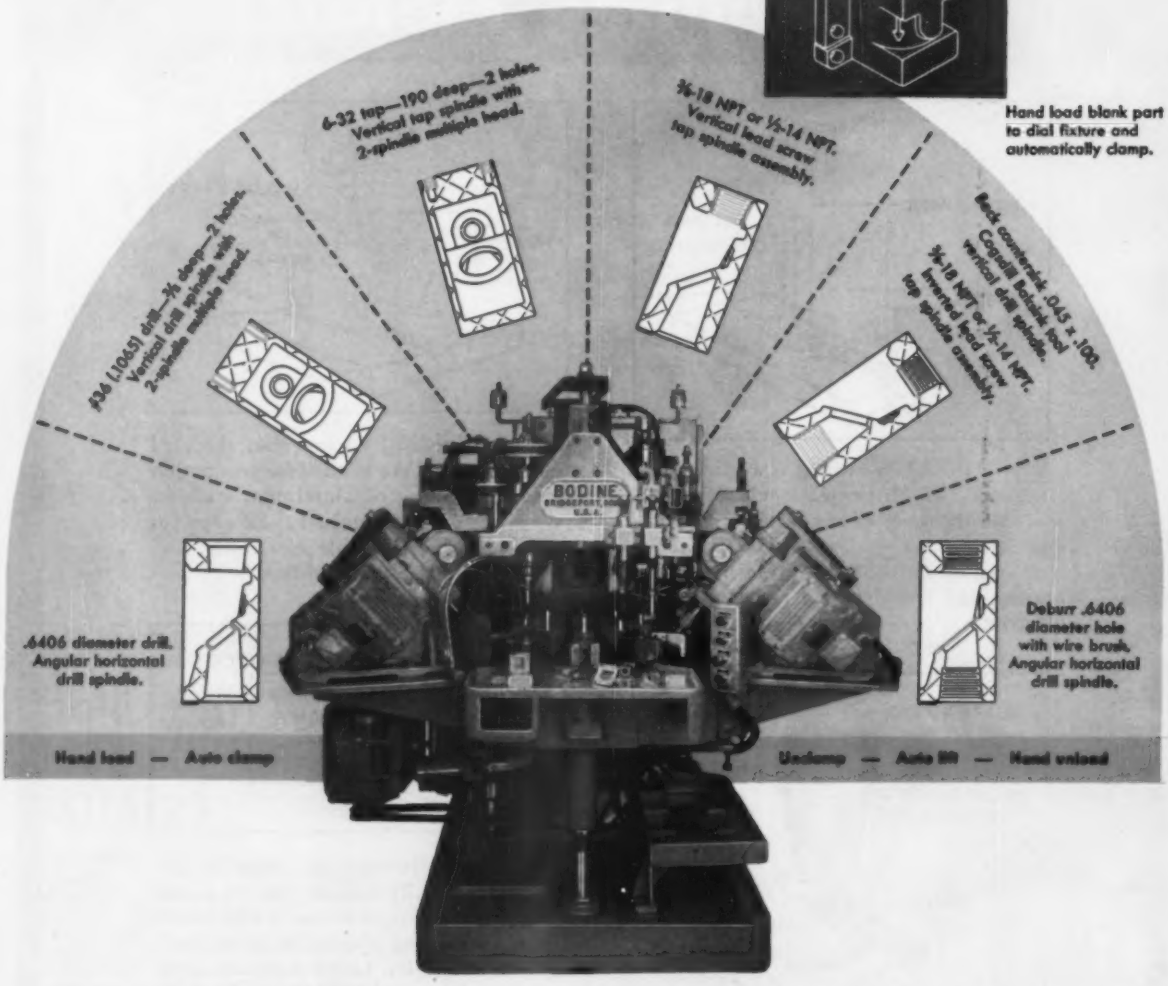
Bodine case history no. 46



Hand load blank part to dial fixture and automatically clamp.


6-32 tap—.190 deep—2 holes. Vertical tap spindle with 2-spindle multiple head.
⅜-18 NPT or ½-14 NPT. Vertical lead screw tap spindle assembly.
Back counterbore .645 ± .100. Cogsdill Balanset tool vertical drill spindle.
⅜-18 NPT or ½-14 NPT. Inverted lead screw tap spindle assembly.
#36 (.1065) drill—⅞ deep—2 holes. Vertical drill spindle with 2-spindle multiple head.
.6406 diameter drill. Angular horizontal drill spindle.
Deburr .6406 diameter hole with wire brush. Angular horizontal drill spindle.
Hand load — Auto clamp
Unclamp — Auto lift — Hand unload
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Good way to hold a winning hand

in competitive manufacturing.

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The interesting new Bodine unit shown above went in to replace another machine . . . to include MORE OPERATIONS, performed at a FASTER RATE.

The new machine features recently-developed Bodine reversing motor-driven lead screw spindles . . . one vertical and one inverted. The valuable versatility of Bodine tooling with combinations of vertical, angular and inverted spindles is clearly demonstrated.

This is also an example of how advanced Bodine tooling is constantly stepping ahead of production demands, even among present Bodine users. In all cases, such tooling is readily adapted to present Bodine Basic units, an important cost-advantage users of our equipment enjoy.

If you have a part you would like to produce better at lower cost, send us a sample and prints for analysis. No cost or obligation. Write Dept. AM-11.

MATERIAL and PART: Zinc die-cast valve body.

PRODUCTION: 15 complete pieces per min.; 6000 operations per 50-min.hr.

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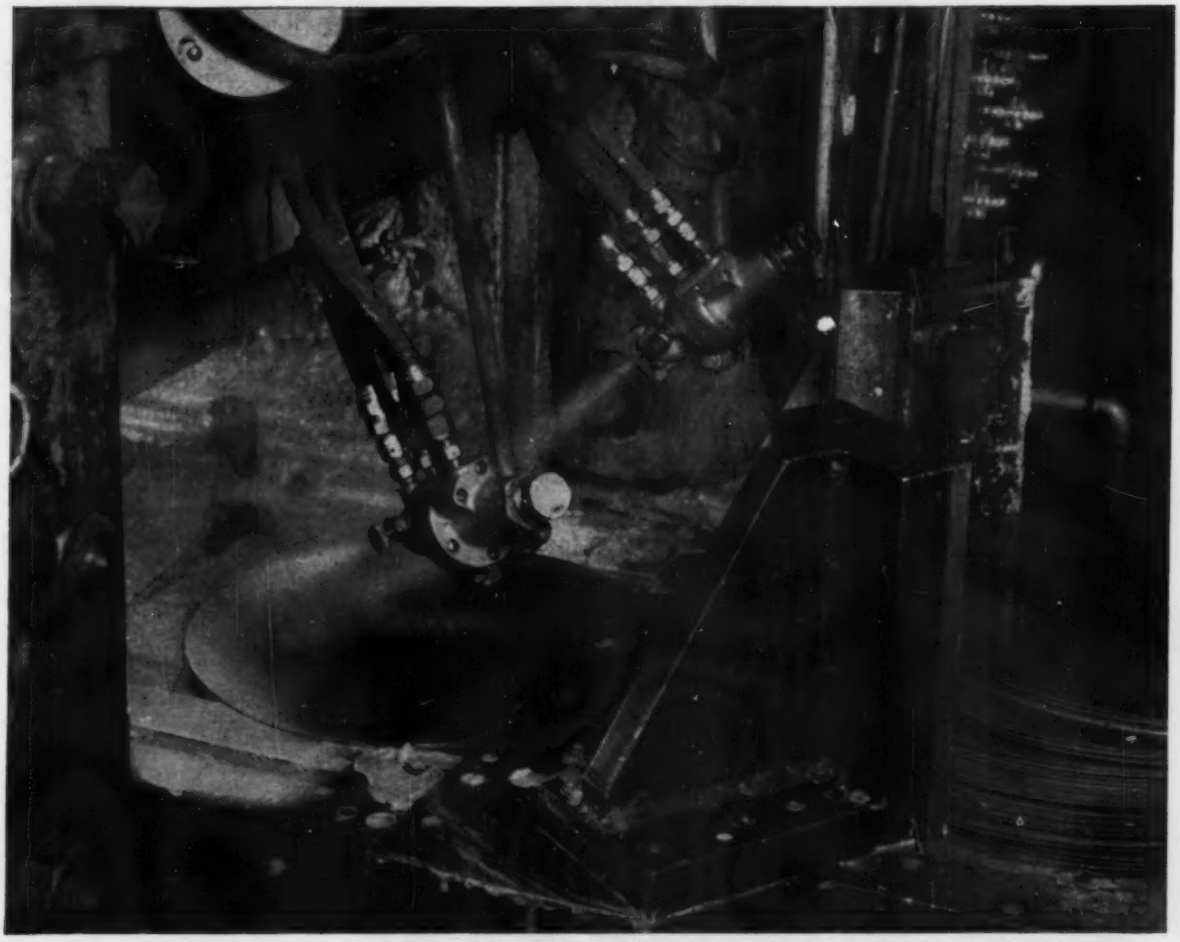

As an automatic feeding device slides another blank into the die, two DeVilbiss WDB Spray Guns apply a measured amount of lubricant—saving material, protecting dies, reducing rejects.

THESE SPRAY GUNS ARE SAVING $18,000 ANNUALLY!

"Applying die lubricants by the DeVilbiss Spray Method has cut our costs for compound, application, and press maintenance *in half*," reports the procurement engineer for one of the nation's largest refrigerator manufacturers. "What's more, malformed and broken parts have been practically eliminated.

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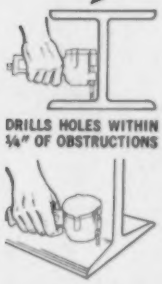

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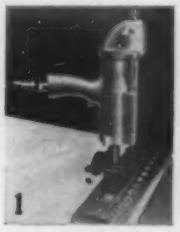
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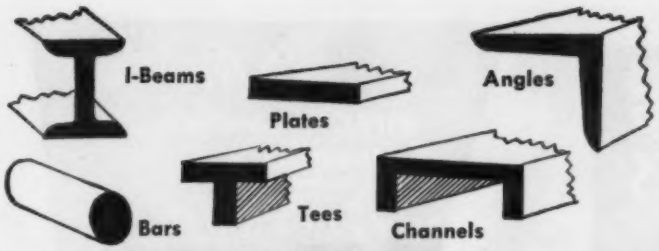

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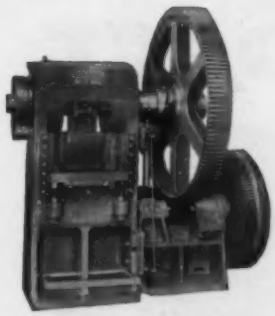
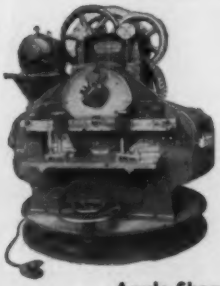


Bar Shears



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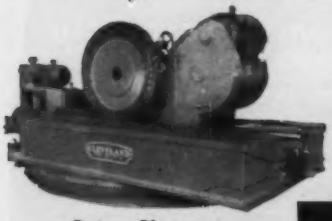

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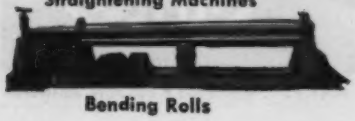

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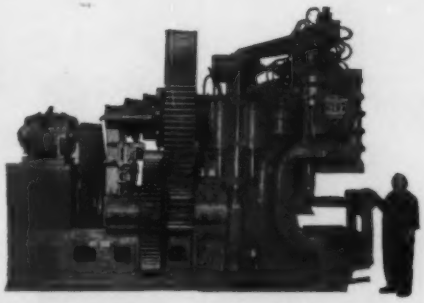

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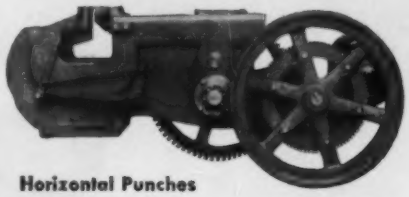
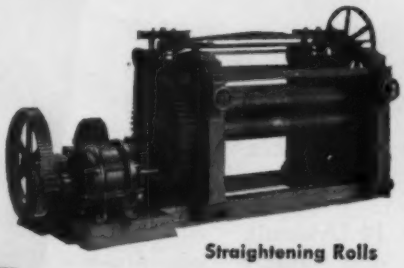
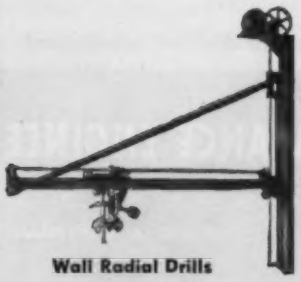


Horizontal Punches



Straightening Rolls



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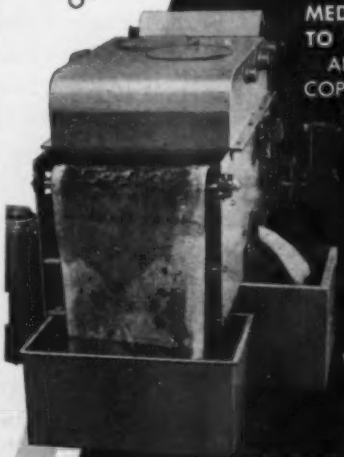

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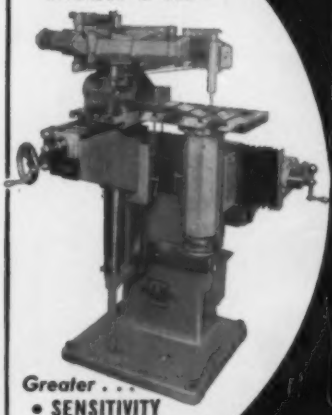

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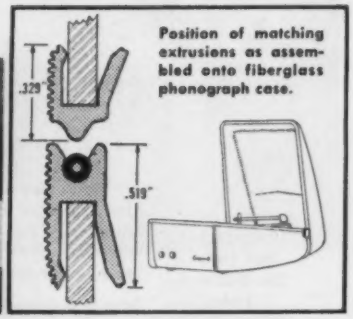
800 Bends An Hour

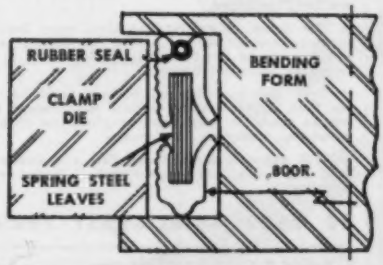
IN ANODIZED EXTRUSIONS ON PINES MODEL ¾ BENDING MACHINE

View of 12-year old Pines Model ¾ Bending Machine at Kinkead Industries Incorporated, Chicago, bending decorative aluminum extrusion closure strips.



Position of matching extrusions as assembled onto fiberglass phonograph case.

Close-up showing tooling employed in bending two matching extrusions simultaneously. Black strip separating two extrusions is spring-steel mandrel used to prevent collapse of open sections during bending.



Extrusions are positioned in tools as illustrated above. Die surfaces are nylon coated to prevent scratching the anodized finish. Rubber seal is installed in straight lengths before bending.

How Accurate Bending Simplifies Fitting of Scratch-Free, Matching Closures on Phonograph Cases

A unique tooling setup on a Pines Model ¾ Bending Machine enabled Kinkead Industries Incorporated, of Chicago, to fill an order for accurate 90° bends in matching aluminum extrusions. Bends are made simultaneously in a pair of extrusions at net production averages of 800 bends, or 100 pair of frames, per hour. Accurate forming simplifies corner fitting and assembly of the completed pieces used as closure strips on phonograph cases. As illustrated, the two extrusions are mounted on spring-steel strips which serve as an internal mandrel and prevent collapse of the sections in the bend area. Bending the two strips simultaneously assures perfect mating when assembled onto the fiberglass cases.

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Before bending, both of the extruded shapes are anodized to a beautiful, bright finish. Die surfaces are faced with nylon to protect the decorative finish and prevent marring during the bending operation. No lubrication is required. The uniform accuracy of the bending operation also eliminates any need for trimming the precut stock. The ends meet in a butt-fit. Kinkead's fine line of stainless steel and aluminum products, known as "Kintrim," is another example of the quality bending results that have long been achieved on Pines Benders. Look to Pines for the practical solution to *your* bending problems.

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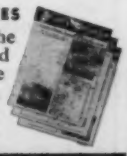

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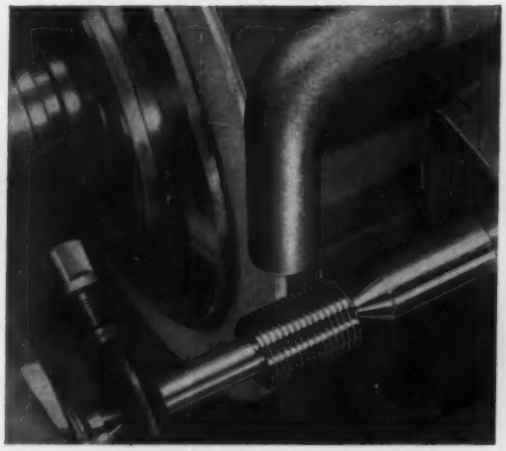

Automatic Grinding Cycle With a Reishauer RAG, thread grinding now becomes *automatic*—saving production steps and time on a wide variety of small parts. Once set-up is accomplished, the operator need only change workpieces.

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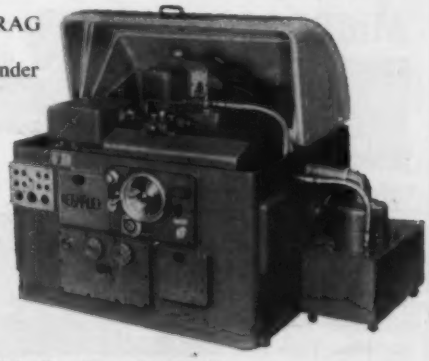
Reishauer RAG Automatic Thread Grinder



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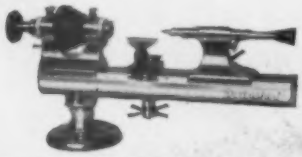

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Center Height—5 CM, Collet Capacity—.1969"

ELECT LATHE — 18" BED
Center Height—2.35" (6 CM)
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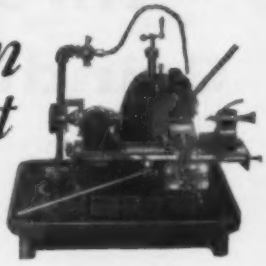

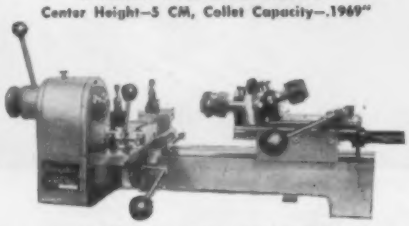

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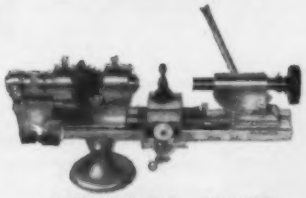

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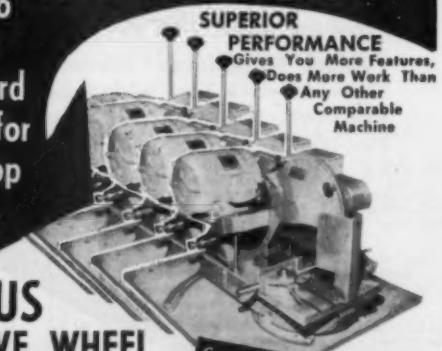

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New Quick-Tilt© spindle can increase your grinder production 50%

Converts from roughing to finishing in seconds

Until now, users of vertical-spindle surface grinders have had to compromise either accuracy or production because of the difficulty in tilting the wheel spindle. In fact, to combine high stock removal with fine finish and flatness meant paying for two operations instead of one.

Now it is possible to tilt the spindle by just turning a selector switch. You have power-tilting to eliminate wheel drag when roughing, yet in a matter of seconds the grinding wheel can be reset to the flat position for finish grinding.

Simple, isn't it? You might even ask: "Why didn't you think of this ten years ago?" Actually, the real significance of this feature lies in the new thinking about surface grinding as a stock removal operation. Ten years ago grinding was considered a finishing process. Therefore, it was not until we had proved the direct and indirect cost savings made possible by grinding from the rough that the need for power-tilting spindles became imperative.

Production tests in our Methods Laboratory show that the average grinding operation can be at least 50% more efficient—that's comparing one machine with the wheel set flat against one on which the cycle is divided between roughing and finishing. But, the profit significance of power-tilting shows up more dramatically when *grinding* through outer scale and burned edges instead of milling or planing.

How to increase stock removal

With a tilted spindle your motor horsepower is applied over a smaller wheel area for greater grain penetration. This produces a bigger chip. You can use harder wheels and still get breakdown.

Fig. 1—Turning the selector switch automatically tilts the spindle .010 in. toward the leading edge, or back to dead flat.

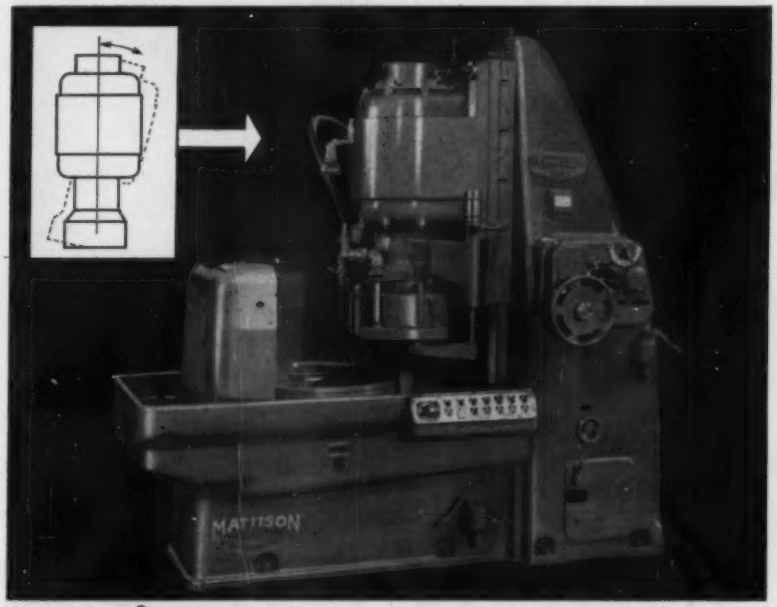

Fig. 2—Quick-Tilt© spindles solidify all the accuracy and stock removal features built into Mattison No. 24 and 36 rotaries. These machines are being built with spindle motors up to 60 hp to provide optimum cutting speeds on stock-removal operations.

With modern casting and forging techniques, there is no reason why stock allowances should not be specified for rough grinding of flat surfaces. This means a saving of approximately 50% of the stock allowance normally required for tool or cutter finishing. If close tolerances or finish are requirements, think of the dual advantages by grinding.

Hard spots, scale, and burned edges are no problem. We can show you examples of savings on parts such as bolster plates, forging dies, pump castings, and forged steel chain links.

Increases accuracy of small parts

With the practical elimination of curvature during the finish grind, more small parts can be ground per table load and setups can be speeded because the work need not be centered in relation to the wheel "ellipse." You use the same, easily adjusted clearance for every job. Leave enough stock for finishing and it is possible to grind over the full diameter of the wheel and still hold precision tolerances on all parts whether they're located at the outer edge or under the low point.

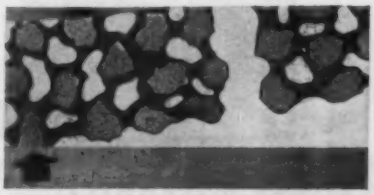

Fig. 3—Tilting the spindle reduces contact area between segments and work, permits use of higher horsepower and harder wheels. Slight bevel at leading edge reduces contact area for finishing.

See a demonstration

We are producing perfect diamond finishes on parts having large, uninterrupted surfaces. We can show you production savings, wheel life, and accuracy on test jobs or your own. Your Mattison dealer will make all the arrangements.

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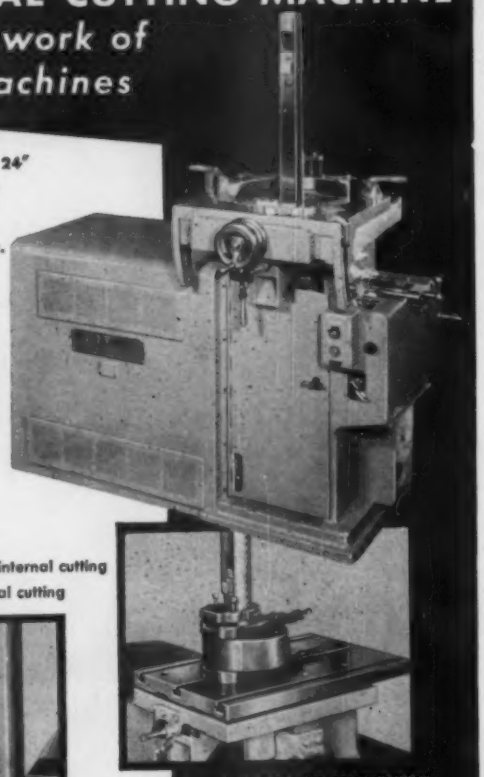
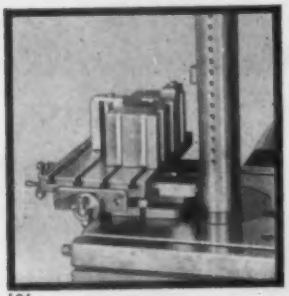


Right: Set-up for internal cutting

Below: Set-up for external cutting



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What's Ahead? . . . see Page 2

Yes, American Machinist's "Chips" column on page 2 of each issue forecasts coming events in future issues, and also points up behind-the-scenes stories of how current articles are gathered and written. Form the "Chips" habit—read it every issue.

American Machinist

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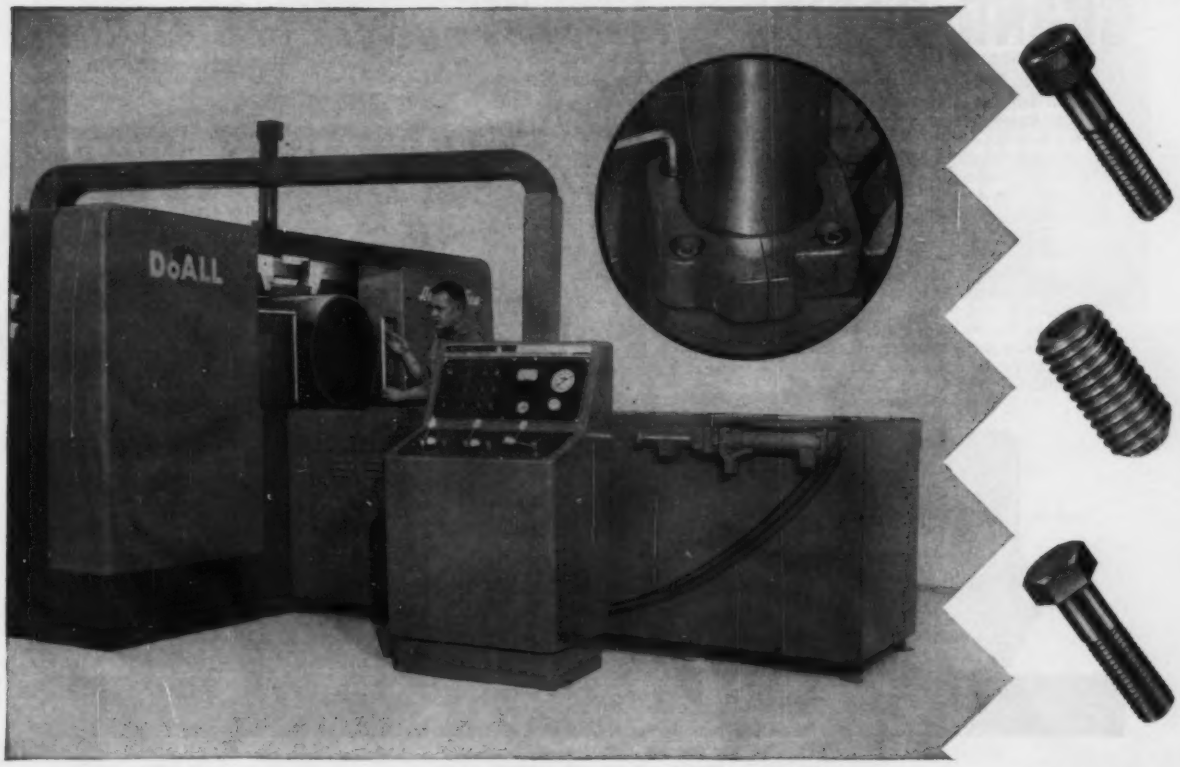
IT PAYS TO STANDARDIZE ON STANSCREW



Stanscrew fasteners meet DoALL standards for high strength, rigidity, "clean" design

This outstanding machine was developed by the DoALL Company to handle industry's largest, toughest cut-off jobs. Not a beefed-up model of existing machines, this "biggest band saw built" is a unique new design. As one example, the cutting head travels vertically, but cutting takes place on the lower edge of the top saw band.

The new design of this unit, Model C24, therefore represents an entirely new concept of rigidity, applied power, and precision control. These basic considerations dictated the selection and application of every part . . . including, of course, the fasteners.

Small wonder, then, that DoALL's design engineers, after consultation with Stanscrew's fastener specialist, selected Stanscrew socket cap screws for vital applications such as attaching hydraulic cylinders. These reliable fasteners provide the high strength needed. Correctly applied, they give assurance against misalignment even after extensive use—a must in this precision machine. And, by permitting flush, snag-free surfaces, the fasteners also contribute to the C24's superior styling.

Like DoALL, other leaders of American industry are learning the advantages of calling in a Stanscrew specialist when a new product is on the drawing boards. His wide experience can often suggest ways to cut fastener or assembly costs . . . for example, by substituting a standard fastener for a costly special. He can make suggestions from Stanscrew's complete line of over 4,000 types and sizes, always in stock and quickly available.

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STANSCREW FASTENERS

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Now high speed, production grinding can enjoy the same Grand Rapids accuracy that's always been a "must" for the toolroom. The Grand Rapids Model F Production Type Hydraulic Feed Surface Grinder offers the same micro-metric precision that has made Grand Rapids famous for accuracy everywhere.

Table speed up to 150 ft. per minute, motor driven coolant system, built-in wheel dresser, one-piece upright column, 20" diameter wheel, Vickers tandem pump control, and a host of other features that make it easy to operate, profitable to own.

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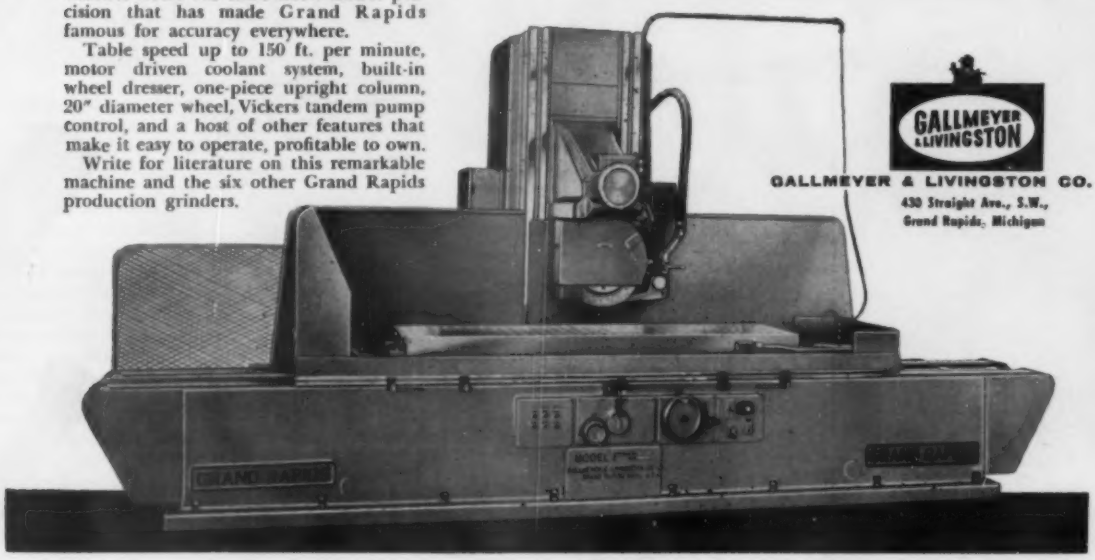

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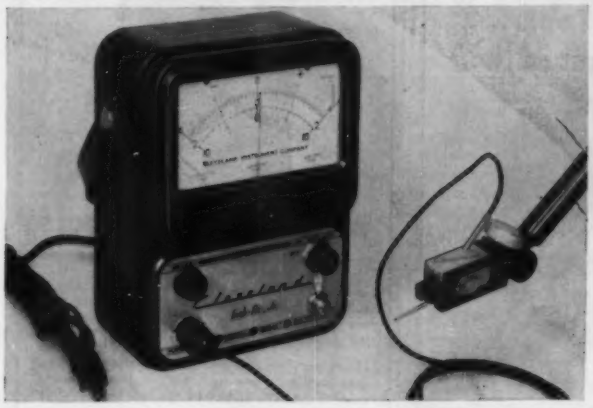

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No. 75 Fellows, H.S. m.d.
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GRINDERS, CYL. 4" x 12" No. H Landis, 1943
GRINDERS, UNIV. 14"x14" Mod. 112 Rivett, 1942
GRINDERS, CYL. 20"x72" Landis, 1943
GRINDER, INT. 72A5 Heald, Univ., Hydr.
GRINDER, INT. No. 74 Heald Hydr., plain, 1941
GRINDER, INT. No. 75A Heald hand feed
GRINDER, SURF. 14"x48" Mattison, 1942
GRINDER, SURF. 20" and 24" No. 25A Heald
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GRINDER, CUTTER. 30" Ingersoll, 1942
GRINDER, CARBIDE. Nos. 48 & 49 Excello, 1941
GRINDER, RADIUS. No. 49 Van Norman, late
GRINDER, TOOL & CUTTER. No. 2 Cincinnati
HOB SHARPENER. Type HRS Barber Colman
KELLER, BL 2416 Pratt & Whitney 3 Spdl., 1941
LATHE, ENGINE, 14" South Bend, late
LATHES, ENGINE, 13", 15" & 17" LeBlond, New
MILLER, AUTO. 48" No. 33 Sundstrand
MILLER, HAND, No. 2RV Kent-Owens, 1942
MILLERS, No. 10 & 3 Van Norman Duplex
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MILLER, PLAIN, No. 2 Cincinnati
MILLER, VERTICAL, No. 2 Brown & Sharpe, 1943
MILLER, No. 36 VanNorman, ram type 1942
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ROUTERS, Type A-1R Onsrud Radial 84", late
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INDEX TO ADVERTISERS

This index is published as a convenience to the readers. Every care is taken to make it accurate, but AMERICAN MACHINIST assumes no responsibility for errors or omissions.

	Page
Accurate Bushing Co.	346
Acra-Ment, Sealol Corporation	276
Acromark Company	401
Adamas Carbide Corp.	362
Alemite	295
Allegheny Ludlum Steel Corp.	353
Allen Mfg. Company	283, 284-285, 286
Allison-Campbell Div. American Chain & Cable Co., Inc.	324
Aluminum Company of America Fasteners	380
American Brass Company	361
American Chain & Cable Co., Inc. Allison-Campbell Div.	324
Wilson Mechanical Instrument Div.	356
American Gage & Machine Co.	335
American Saw & Mfg Co.	261
American Schiese Corp.	317
American Smelting & Refining Co.	329
American Steel & Wire Division	120
American Steel Foundries Elmes Engineering Division	78
King Machine Tool Division	230
American Tool Works Company	75
American Waldrich Mfg. Corp.	316
Ames Company, B. C.	365
Armstrong Blum Mfg. Co.	45
Armstrong Brothers Tool Company	86
Atkins Saw Division Borg-Warner Corporation	331
Atlantic Refining Company	366
Atlas Press Company Clausing Division	342
Atrax Company	287
Avey Division of Motch & Merryweather Co.	30-31
Backus Machine Works	392
Baird Machine Company	292
Baker Brothers, Inc.	35, 36-37, 38
Balance Engineering Co.	386
Barber-Colman Company	46-47
Bath & Co., Inc., John	343
Bausch & Lomb Optical Co.	255
Baush Machine Tool Co.	3rd Cover
Bay State Abrasive Products Co.	56-57
Beatty Machine & Mfg. Co.	289
Bellows Company, Div. International Basic Economy Corp.	63

(*Continued on page* 400)

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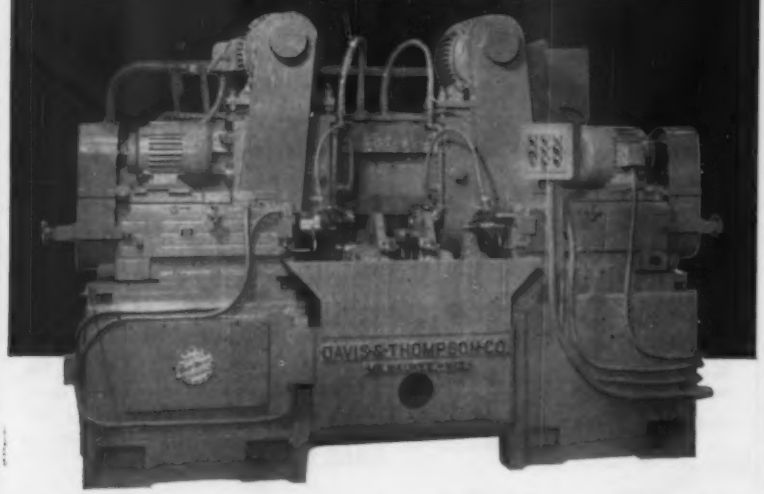

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INDEX TO ADVERTISERS

(Continued from page 399)

	Page
Benchmaster Manufacturing Co.	364
Bethlehem Steel Company	355
Bilgram Gear & Machine Company	400
Blake Company, Edward	276
Blanchard Machine Co.	360
Bliss Company, E. W.	266
Bliss & Laughlin, Inc.	320-321
Bodine Corporation	382
Boston Gear Works	370
Bridgeport Machines, Inc.	358
Brown & Sharpe Mfg. Co.	99, 104
Brush Instruments, Div. Clevite Corp.	278
Bryant Chucking Grinder Co.	60
Buffalo Forge Co.	72-73
Bullard Co.	108
Bulldog Electric Products Co.	333
Bunting Brass & Bronze Co.	264
Burg Tool Manufacturing Co.	88-89
Butterfield Division of Union Twist Drill Company	40
Carpenter Steel Company	41
Chambersburg Engineering Co.	348
Champion Pneumatic Machinery Co.	335
Chicago Screw Co.	395
Cincinnati Gear Co.	272
Cincinnati Gilbert Machine Tool Co.	249
Cincinnati Lathe & Tool Co.	87
Cincinnati Milling Machine Co.	
Grinding Machine Division	16-17
Milling Machine Div.	4-5
Cincinnati Shaper Co.	122
Circular Tool Company	334
Clausing Division Atlas Press Co.	342
Cleveland Automatic Machine Co.	119
Cleveland Crane & Engineering Co.	277
Cleveland Grinding Machine Co.	293
Cleveland Instrument Co.	397
Cleveland Punch & Shear Works Co.	385
Columbia-Geneva Steel Div.	52-53, 120
Columbus Die-Tool & Machine Co.	305
Commercial Filters Corporation	374
Cosa Corporation	391
Crane Packing Company	378
Cross Company	28-29
Cushman Chuck Company	112
Danly Machine Specialties, Inc.	315
Davis & Thompson Co.	400
Derbyshire Inc., F. W.	392
Detrex Chemical Industries, Inc.	332
DeVilbiss Company	383
DeVlieg Machine Co.	306-307
DoAll Company	291
Dreis & Krump Manufacturing Co.	273

INDEX TO ADVERTISERS

	Page
du Mont Corporation	96
Dykem Company	396
Ekstrom, Carlson & Co.	345
Elmes Engineering Division American Steel Foundries	78
Emhart Mfg. Co. V & O Press Co. Div.	294
Engelberg, Inc.	310
Errington Mechanical Laboratory	352
Ex-Cell-O Corporation	64-65, 100
Fafnir Bearing Company	70
Famco Machine Company	403
Federal Products Corporation	39
Fellows Gear Shaper Company	6-7
Felters Company	290
Foote-Burt Company	225
Fosdick Machine Tool Company	22-23
Frauenthal Division Kaydon Engineering Corp.	296-297
Fulmer Co., C. Allen	338
G & L Hypro Division Giddings & Lewis Machine Tool Co.	14-15
Galland-Henning Nopak Division	326
Gallmeyer & Livingston Co.	396
Gardner Machine Company	21
Gay-Lee Company	396
Gisholt Machine Company	71
Gleason Works	3
Gorton Machine Co., George	269
Goss & de Leeuw Machine Company	262
Grant Gear Works, Inc.	327
Grant Mfg. & Machine Company	405
Graphic Systems	368
Greaves Machine Tool Company	330
Greenlee Brothers & Company	110
Grieder Industries	376
Gulf Oil Corporation	68-69
Hamilton Tool Company	402
Hanchett Magna-Lock Corp.	349
Hanson-Whitney Company Division of Whitney Chain Co.	314
Hardinge Brothers, Inc.	101
Hartford Machine Screw Co.	395
Heald Machine Company, Sub. Cincinnati Milling Machine Co.	2nd Cover
Heller Tool Company, Subsidiary Simonds Saw & Steel Co.	61, 62
Hill Acme Co., Acme Machine Div.	300-301
Hydraulic Press Mfg. Co., Div. Koehring Company	311
Hydreco Division, New York Air Brake Co.	303

(Continued on page 402)

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INDEX TO ADVERTISERS

(Continued from page 401)

	Page
I-T-E Circuit Breaker Co. Transformer & Rectifier Div.	406
Infilco, Inc.	386
Ingersoll-Rand Company	373
Jacobs Mfg. Company	341
Jahn Manufacturing Co., B.	260
Johnson Machine Co., Carlyle	318
Johnson & Bassett, Inc.	388
Jones & Lamson Machine Co.	106
Kearney & Trecker Corporation	258-259
Kennametal, Inc.	323
Kent-Owens Machine Company	116
King Machine Tool Div., American Steel Foundries	230
Kingsbury Machine Tool Corp.	254
L & J Press Corporation	405
L W Chuck Company	399
Landis Machine Company	8-9
Landis Tool Company	10-11
Lange Engineering, Erich	368
LaPointe Machine Tool Company	26-27
LeBlond Machine Tool Co., R. K.	24-25
Lees-Bradner Company	368
Leland-Gifford Company	97
Le Maire Machine Tool Co.	379
Lilly & Co., Eli Agricultural & Industrial Products Div.	94-95
Lincoln Electric Company	359
Linde Div., Union Carbide Corporation	381
Linley Brothers Co.	372
Littell Machine Co., F. J.	299
Lodding, Inc.	372
Lodge & Shipley Company	66
Logan Engineering Co., Lathe Div.	363
Lufkin Rule Co.	304
Manhattan Rubber Div. Raybestos-Manhattan, Inc.	344
Mattison Machine Works	393
M.B.I. Export & Import, Ltd.	328
McDonough Manufacturing Co.	268
McGraw-Hill Book Co., Inc.	346
Metallurgical Products Dept., General Electric Company	92-93, 351
Mettler Machine Tool, Inc.	376
Micromatic Hone Corp.	308-309
Mid-West Abrasive Company	98
Midwest Gage Laboratory	335
Milford Rivet & Machine Co.	267

INDEX TO ADVERTISERS

	Page
Miller Corporation, Harry	369
Miller Electric Mfg. Co.	401
Miller Pattern & Mfg. Co.	376
Mitts & Merrill	394
Monarch Machine Tool Company	90-91
Morse Twist Drill & Machine Co.	12-13
Motch & Merryweather Machinery Co.	54-55
Mueller Brass Company	375
National Machine Tool Co.	399
Nelco Tool Co., Inc.	99
New Britain Machine Company New Britain Gridley Machine Div.	43, 44
New England Tap Co.	337
New York Air Brake Co., Hydreco Div.	303
Niagara Machine & Tool Works	263
Nilson Machine Co., A. H.	322
Norton Company	18-19, 33, 34
Nutap	368
Oakite Products, Inc.	319
Oliver Corp., A. B. Farquhar Div.	270
Oliver Instrument Company	312-313
Olivetti Corporation of America	357
Olofsson Corporation	271
Orban Co., Inc., Kurt	245
Pacific Industrial Manufacturing Co.	226
Pines Engineering Co., Inc.	389
Pipe Machinery Company	354
Portage Machine Co.	377
Pratt & Whitney Co., Inc.	252-253
Producto Machine Co.	371
Raybestos Manhattan, Inc.	344
Republic Steel Corp.	48-49
Roto-Finish Company	336
Rotor Tool Company	76-77
Ruthman Machinery Company	288
Ryerson & Son, Inc., Joseph T.	114
S.K.F. Industries, Inc.	387
Scherr Co., Inc., George	392
Schrader's Son, A., Div. Scovill Mfg. Co., Inc.	85
Scott Paper Company	257
Sheffield Corp. of Bendix Aviation	20
Simonds Gear & Mfg. Co.	268
Sinclair Refining Co.	339

(*Continued on page* 404)

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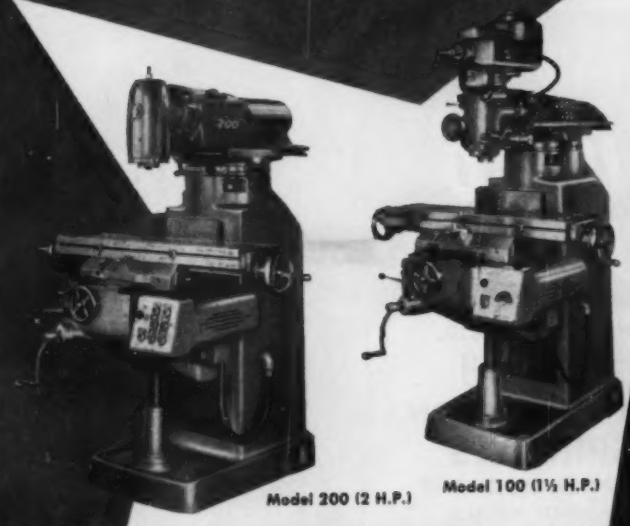

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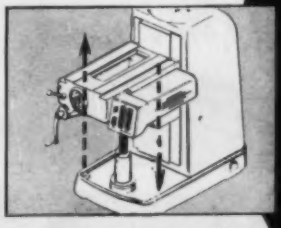

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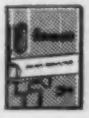

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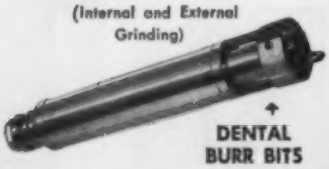

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INDEX TO ADVERTISERS

(*Continued from page 403*)

	Page
Size Control Company Div. American Gage & Machine Co.	335
Smith Corporation, A. O.	79-84
Socony Mobil Oil Co., Inc. & Affiliates	102-103
Square D Co.	298
Standard Electrical Tool Co.	404
Standard Screw Co.	395
Starrett Co., L.S. The	232
Steelweld Machinery Division Cleveland Crane & Engineering Company	277
Stewart-Warner Corp.	295
Stuart Oil Co., Ltd., D. A.	241, 242
Sundstrand Machine Tool Company	58-59
Surface Combustion Corp.	32
Taft-Peirce Mfg. Company	280-281
Tennessee Coal & Iron Div.	52-53, 120
Thompson & Son Co., Henry G.	274-275

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Michael R. Zeynel, 15, Landgraf-Wilhelm, Frankfurt/Main, Germany

INDEX TO ADVERTISERS

	Page
Thompson Grinder Company	74
Timken Roller Bearing Company Steel & Tube Div.	4th Cover
Torrington Mfg. Company	340
Union Carbide Corporation Linde Division	381
United Shoe Machinery Corporation	251
U. S. Steel Corp.	52-53, 120
United States Steel Export Co.	52-53, 120
United States Steel Supply	52-53, 120
U. S. Tool Co., Inc.	42
Universal Engineering Company	279
V & O Press Co., Div. Emhart Mfg. Company	294
Vascaloy-Ramet Corporation	247
Vickers, Inc.	67
Vlier Engineering Corp., Sub. Barry Controls, Inc.	228
Wacker Sales	335
Wales Strippit Company	302
Walker Turner Div. Rockwell Mfg. Co.	367
Walsh Press & Die Co.	335
Wean Equipment Corp.	347
Wells Mfg. Co.	256
Western Automatic Machine Screw Co.	395
Westinghouse Electric Corp.	50-51
Whitnon Mfg. Co.	390
Whiton Manufacturing Co.	380
Wiedemann Machine Co.	265
Wilson Mechanical Instrument Div., American Chain & Cable Co., Inc.	356
Winslow Product Engineering Corp.	384
Wood Co., R. D.	350
Zagar, Inc.	282

CLASSIFIED ADVERTISING

F. J. Eberle, Business Mgr.

EMPLOYMENT OPPORTUNITIES	397
EQUIPMENT (Used or Surplus New) For Sale	397-398
WANTED Equipment	397

ADVERTISERS INDEX

Aaron Machinery Company	397
Cleveland Machinery Sales	397
Falk Mill Supply Co., Inc.	398
Hyman & Sons, Joseph	398
Machinery & Steel Division	398
Miles Machinery Company	398
Tait Manufacturing Co., The	398
United Mineral & Chemical Corp.	397

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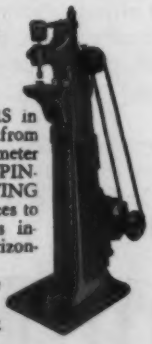

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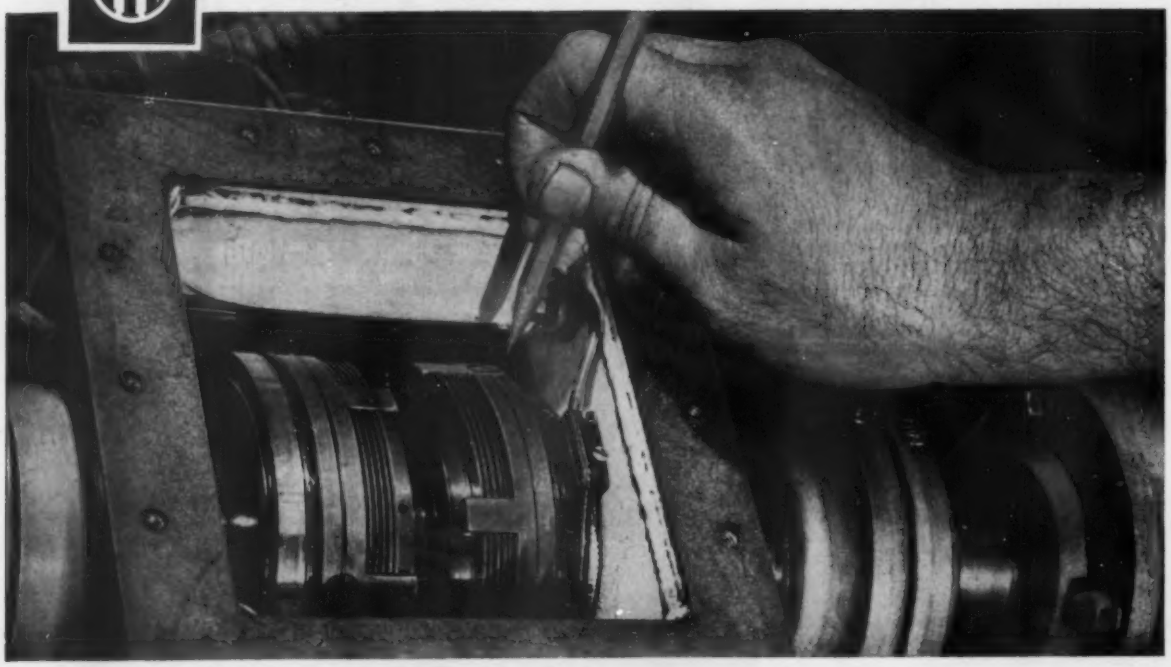

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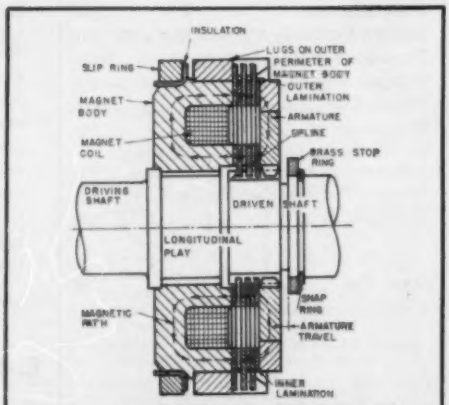

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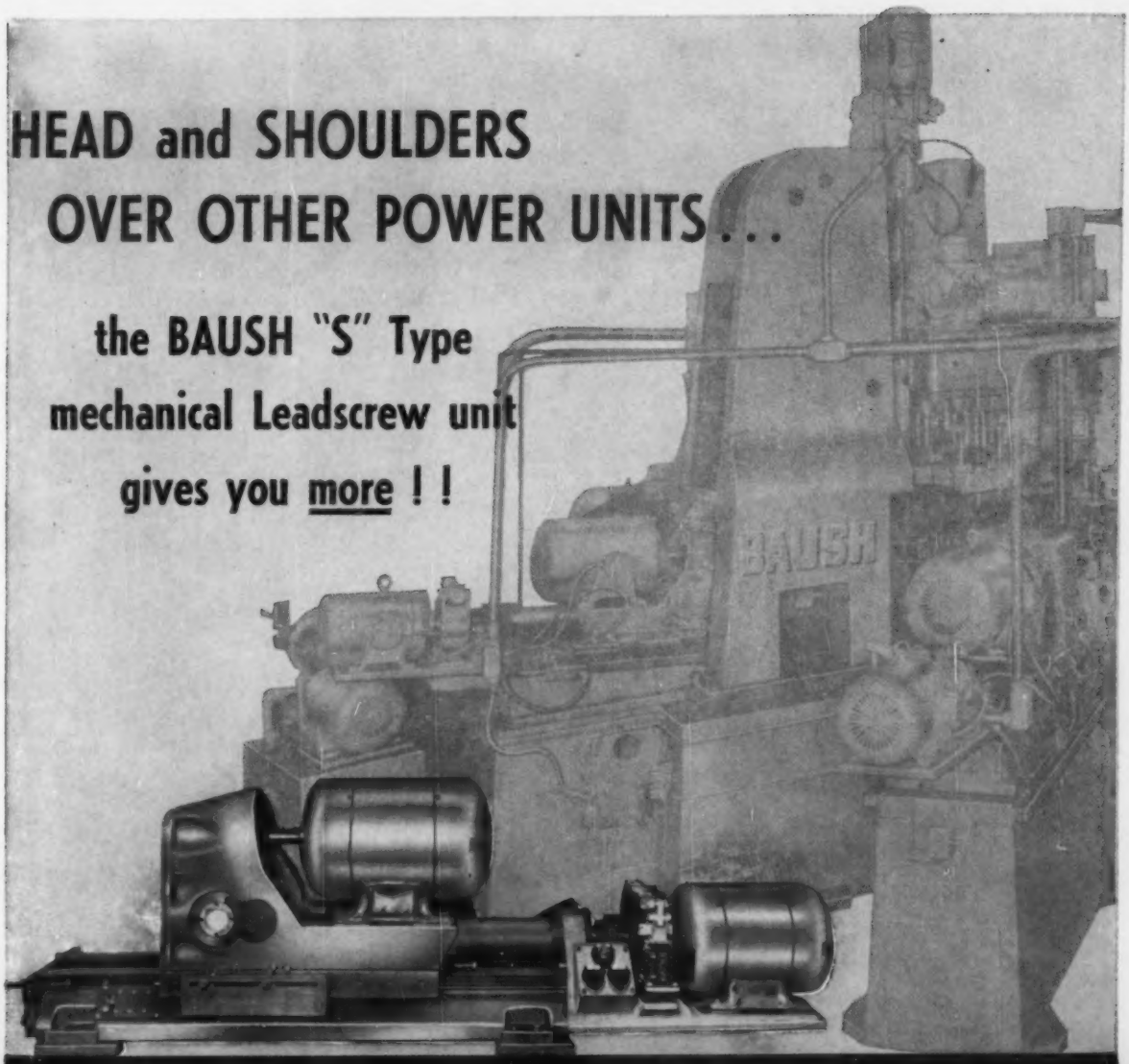

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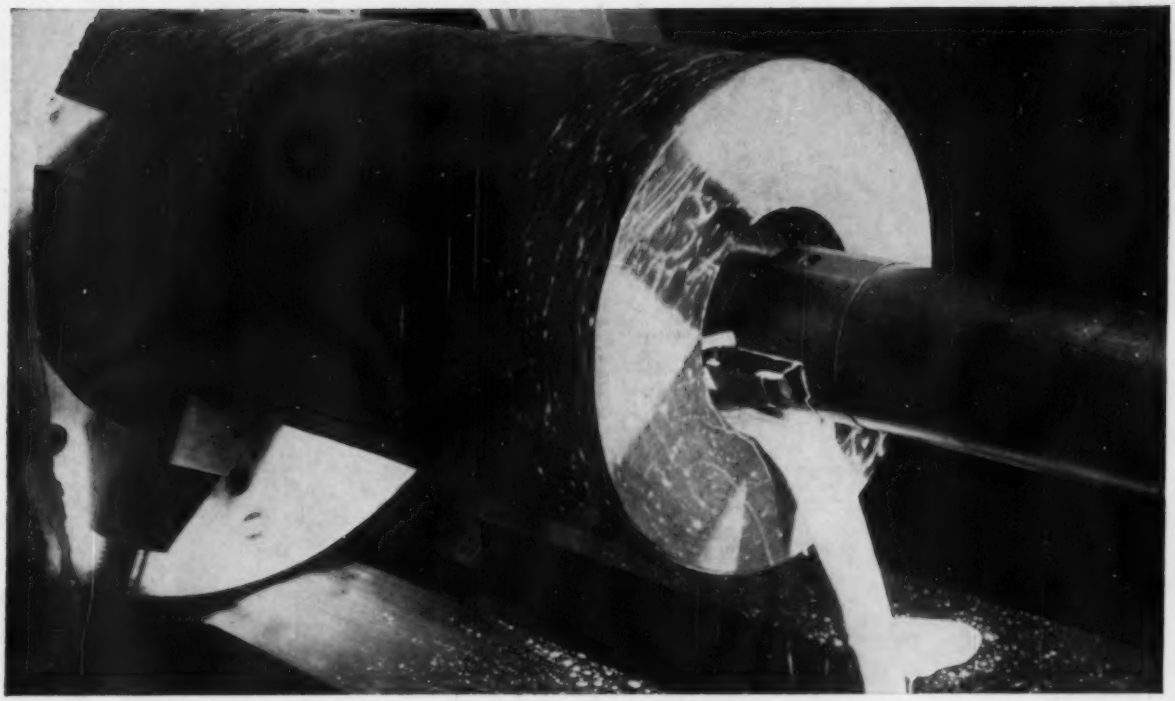

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